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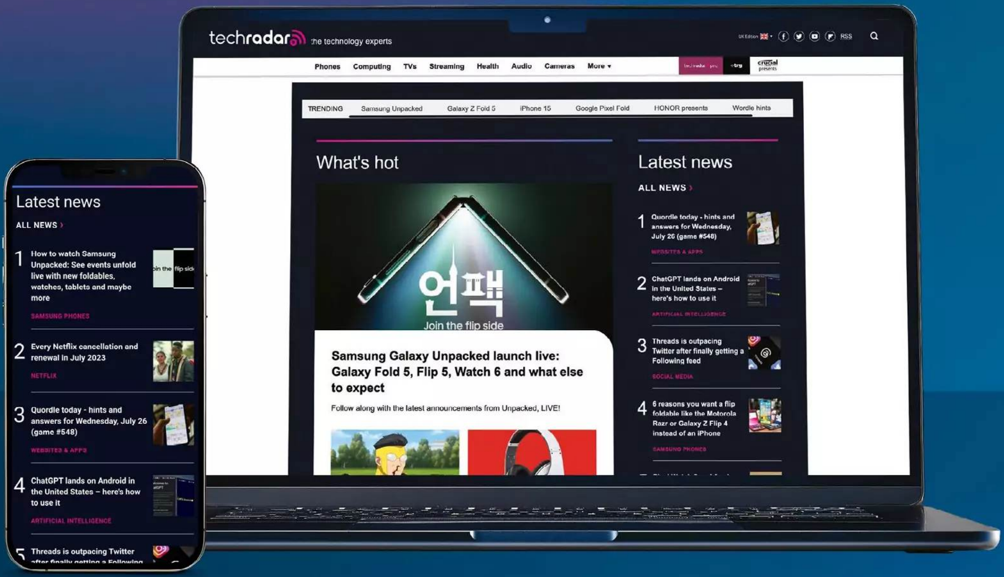

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Guy
Cocker

BACK TO THE FUTURE

HELLO AND WELCOME to this very forward-looking edition of *Maximum PC*. This issue, we're giving you our take on two of the latest developments in the PC world. The first is a deep dive into the world of AI: what you can do with the tech everyone's talking about, where it might all be heading, and if you should be concerned whether your next PC is 'AI certified' or not. The second is our first build using the brand new 'BTF' form factor, a new standard that aims to make desktop PCs easier to build, cleaner to look at, and generally just less of a mess of cables.

When it comes to 'artificial intelligence', I can't blame you if the recent overuse of the term now results in an eye-roll whenever you hear it. There's bound to be some scepticism from hardcore desktop PC users, who are seeing Qualcomm, Microsoft, HP, and many others co-opt the term, dollar signs flashing in their eyes as they see a chance to make a quick buck. However, I quote our writer Zak Storey here when he says he's "very much an AI convert now" after penning our cover feature.

Zak's piece is very much the *Maximum PC* take on the tech in 2024, with a deep dive on how it works, what's next, and whether we need to heed the warnings of countless sci-fi novels and movies about the dark place this is all leading to. His full breakdown begins on page 32.

Zak is also behind our first ever BTF PC, thanks to the help of Asus, who shipped him a specialized case, motherboard, GPU, and more for our cover build. The new BTF standard moves the vast majority of the motherboard's power and data connectors on the rear of the board, so you no longer have to look at unsightly cables through the glass panels of your lovely new PC chassis. As anyone who's done their own build in the last couple of years will know, cable management has only gotten worse, especially thanks to the latest GPUs and their power demands. The decision to put those 8-pin connectors at the most visible part of the graphics card was anything but elegant, but it's at least now being addressed.

Of course, as with anything new, you're going to pay the price for such innovation. The resulting build comes in at an eye-watering $4,800. This may put a lot of people off, but as an early indication of where PC building could be going in the coming years, it's fascinating. Thankfully, you don't need to pay anything to check out what I think is our most interesting build of the year so far—just head to page 16.

The other theme for this issue is sadly not as much fun—the technical problems Intel's had with its 13th and 14th Gen CPUs. Developers discovered technical problems a couple of months ago, and Intel's subsequent silence on the matter has caused concern that a costly product recall may be needed. Jeremy Laird's Trade Chat column on page 13 calls it nothing short of an existential crisis for the company, while we've taken the unprecedented step of removing the affected chips from our Blueprint builds (see pages 96-98). We'd hold off on buying any Raptor Lake processors for now, and wait for hopefully a positive update next month.

Enjoy the issue!

Guy Cocker

Guy is Maximum PC's *editor-in-chief. He built his first gaming PC in 1997 to play* Tomb Raider *on 3dfx, and has been obsessed with all things PC ever since.*

↘ submit your questions to: editor@maximumpc.com

THE NEWS

AMD Ryzen 9 9950X Specs Leaked

CPU looks to leave Intel's Core i9-14900KS in the dust

IN MID-MARCH, the PC world got a new CPU king with the release of the Intel Core i9-14900KS, touted as the fastest processor in history. This was in light of a dedicated team of enthusiasts at Asus using a combination of liquid helium and elbow grease to overclock the 24-core chip to 9,117 MHz on a single P-core.

It was only a matter of time before this 14th Generation Raptor Lake Refresh chip met its match. According to AnandTech forum member, Igor Kavinski, this has already happened. On July 18, he began publishing the benchmarks of the AMD Ryzen 9 9950X 16-Core 'Zen 5' Desktop CPU at its maximum power potential.

Kavinski has form, having listed how the 16-core flagship scales at various TDP limits in the Blender and Cinebench benchmarks. For instance, when supplied with 160W of power, the 9950X reached the Cinebench R23 score of 48,011 for multi-threaded performance. Kavinski claims his tests revealed that Intel's 14900KS chip would need to run at over 250W to achieve the same. These are based on an engineering sample, which usually have lower clock rates than retail chips.

AMD's flagship CPU looks promising, with two Zen 5 CCDs and a single IOD. The chip will have 16 cores, 32 threads, and a base clock of 4.3GHz. The max boost clock is up to 5.7GHz. The CPU also comes with an 80MB cache (64MB L3 + 16 MB L2), and a TDP of 170W.

Any hardware enthusiast knows that this data can be more helpful in understanding a CPU's daily performance, particularly given how contrived testing can be. For instance, Kavinski engaged in heavy overclocking by applying AMD's Precision Boost Overdrive (PBO), and Curve Optimizer for voltage offset.

He also used 4,800 MT/s DDR5 memory, along with his own custom water-cooling system. This must have been useful, as Kavinski tested the 9950X at various PPT Thresholds, including 310W PPT (Unlimited). Even at this level, the cooling system maintained a chip temperature of 80 C. This is the setup that puts the upcoming Ryzen CPU 12.5 percent ahead of the Intel Core i9-14900KS, though you'll need a similarly big cooling system to match it at home. This said, AMD recommends using an AIO with the Ryzen 9 9000 series of CPUS, so these results may not be far-fetched.

The 9950X also achieved astonishing results at more modest power levels. At 90W, it outperformed the Ryzen 9 5950X while boosting to 5,053MHz. At 120W, the CPU can beat the top processors from both Intel and AMD, while boosting up to 5,555MHz. At 230W, the frequency was even above 5.6GHz.

When in the aforementioned 310W 'Unlimited' PPT mode, this maximum frequency didn't change. However, the overall clock speed across all cores was higher, going over 5.5GHz, a shade over the 5.4GHz speed when deploying the 230W PPT.

A separate test was done to achieve a 5.5GHz static overclock at a PPT of 253W, while hitting a peak temperature of 61 C. This matches Intel's maximum power limit for Core i9 CPUs.

The final results of the test showed that AMD's upcoming CPU saw an improvement of up to 40 percent over the Core i9-14900K and a 38 percent improvement over the Ryzen 9 7950X. However, these tests only compare other CPUs in their stock configurations, while the 9950X was modified through PBO and CO. In particular, the 7950X fares better at lower power levels.

At the time of writing, no pricing information has been released. But AMD has confirmed that the series will also introduce 'Curve Shaper'—an extension to 'Curve Optimizer'. This setting will apparently be accessed from the main OC menu under Curve Optimizer. Once opened, users will be able to add or remove underlying voltage curves to maximize how they undervolt the CPU. **–CL**

> “The AMD Ryzen 9950X CPU seriously outperforms the Intel Core i9-14900KS in tests

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9
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9000 SERIES PROCESSOR
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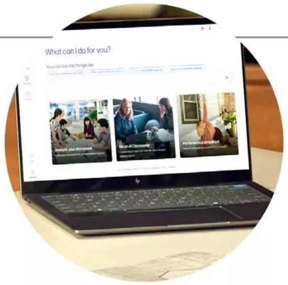
HP REVEALS ULTRA-FAST AI LAPTOP



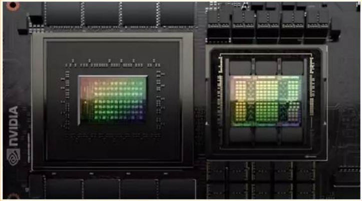
IT WILL BE THE FIRST COPILOT+ PC TO FEATURE AMD'S AI CHIP

IN MAY, Microsoft announced the Copilot + PC Program. AMD responded with the Ryzen AI 300 series. The 55-TOPS (Trillion Operations per Second) of Neural Processing Unit performance would place these chips above both the Snapdragon X Elite (45 TOPS), and Apple's M4 chip in the iPad Pro (38 TOPS).

HP has announced that the Omnibook Ultra 14 laptop will be the first to feature AMD's chips. HP has stated that it won't be released as a Copilot+PC device, but users will receive a free upgrade from Microsoft once it becomes available.

The company has also confirmed that it will feature the AI 300 series processor with integrated AMD Radeon 800M graphics. The laptop is expected to be available at the start of August on HP.com and at Best Buy for a starting price of $1,450. **–CL**

NVIDIA OPEN SOURCES GPU KERNEL MODULES



DESPITE the popularity of NVIDIA chips, the company has had a contentious relationship with the open-source community. Linux developers were frustrated by NVIDIA's refusal to provide code to develop open-source drivers for the OS. In a 2012 interview, Linus Torvalds described them as "the single worst company [we] ever worked with".

Even criminals got in the game. In 2022, Ransomware gang Lapsus$ threatened to leak NVIDIA GPU data files unless they agreed to open-source its GPU drivers for all operating systems forever. NVIDIA declined. But in the same year, it did begin open-sourcing GPU kernel modules. This was done for the R515 driver for data center GPUs, using dual MIT and GPL licensing.

NVIDIA has announced that it plans to do the same for the R560 driver. This will be the final stage in open-sourcing its GPU kernel modules, though NVIDIA's Technical Blog says these won't be compatible with all GPUs. **–CL**

Tech Triumphs and Tragedies

A monthly snapshot of what's good and bad in tech

TRIUMPHS

✓ **NO MAN'S SKY UPDATED**
V5.0 has improved sky, cloud, and water rendering, engine performance, and bug fixes.

✓ **XBOX.COM TO STREAM GEFORCE NOW GAMES**
Microsoft has reaffirmed its commitment to PC gamers using NVIDIA's streaming service.

✓ **'PIVOTAL' QUANTUM CHIP**
The new chip by Oxford Ionics controls 'trapped ions'—a crucial step in building effective quantum computers.

TRAGEDIES

✗ **XBOX 360 MARKETPLACE CLOSED FROM JULY 29**
For those who didn't buy before then, digital-only releases like *Mighty No. 9* are gone forever.

✗ **DISNEY HACKED**
'Hacktivist' group Nullbulge has stolen over 1TB of data from its Slack channels.

✗ **INTEL FAULTY PROCESSORS ACCUSATION**
Alderon claims the 13th/14th-gen Raptor Lake CPUs have almost a 100 percent failure rate.

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DASVIDANIYA KASPERSKY

Kaspersky offers six months of free software before pulling out of USA

ON JUNE 21, the US Treasury Department's Office of Foreign Assets Control (OFAC) sanctioned 12 Kaspersky Lab executives, who were supposedly working in Russia's technology sector. Then, the US Department of Commerce put AO Kaspersky Lab, OOO Kaspersky Group (Russia), and Kaspersky Labs Limited (UK) on its 'Entity List', meaning no US company could do business with them.

Finally, the Department of Commerce's Bureau of Industry and Security (BIS) banned the company from selling software or providing updates. As such, it wasn't surprising that on July 15, Kaspersky announced it would be winding down its US operations from July 20.

In 2017, Bloomsberg Newsweek ran the explosive headline, 'Kaspersky Lab Has Been Working With Russian Intelligence'. The software security firm replied that they'd never received any requests for customer information from the FSB or any other Russian government organization. In the same year, the Department of Homeland Security issued a directive forbidding federal agencies and departments from installing Kaspersky software on their systems.

There was no specific reason for the DHS ban, but media outlets at the time claimed "government sources" revealed that an NSA contractor developing surveillance tools had his software detected as malicious code by Kaspersky, which extracted it from his computer.

Despite attempts by Kaspersky to have its source code validated and relocating core infrastructure from Russia to Switzerland, the US government prevailed.

Kaspersky has posted an announcement for US customers, thanking them for their loyalty and support. In addition, certain Kaspersky products are now being offered free of charge for six months. **–CL**

IT OUTAGE AFFECTS 8.5 MILLION

Microsoft releases statement

ON JULY 19, IT security company Crowdstrike unveiled a 'sensor configuration update' for Windows systems. This triggered a logic error, resulting in a system crash and blue screen for any customers running Falcon Sensor on Windows 7.11 or above.

Microsoft released a statement to the effect that although this comprised less than one percent of devices running its OS, the outage affected 8.5 million devices. The effects were felt by virtually everyone in the developed world, given that systems operated by airlines, stock markets, and TV broadcasters were knocked offline.

According to the UK's *Daily Telegraph*, the company failed to issue any public statements or updates for a few hours. However, a workaround was developed and published on the company blog. Crowdstrike also collaborated with Microsoft to deliver updates. At the time of writing, the fastest remedy is to boot Windows devices into 'Safe Mode' and remove certain .sys files. The effects of the outage could linger for weeks.

This disruption has raised questions about the hegemony enjoyed by a handful of cybersecurity companies. For instance, Crowdstrike claims that around 60 percent of Fortune 500 companies are customers.

Despite the chaos, China managed to escape relatively unscathed, as few organizations there use Crowdstrike. The country also doesn't rely too much on Microsoft Azure, thanks to local cloud providers such as Huawei and Tencent. Russia and Iran are subject to international restrictions on using American software, so reported no major issues.

As it centred on Azure, most personal devices running Windows were unaffected, as were macOS and Linux users.

While the incident unfolded, Microsoft regional director Troy Hunt posted on X: "I don't think it's too early to call it: this will be the largest IT outage in history." **–CL**

Chromium browsers sending information to Google

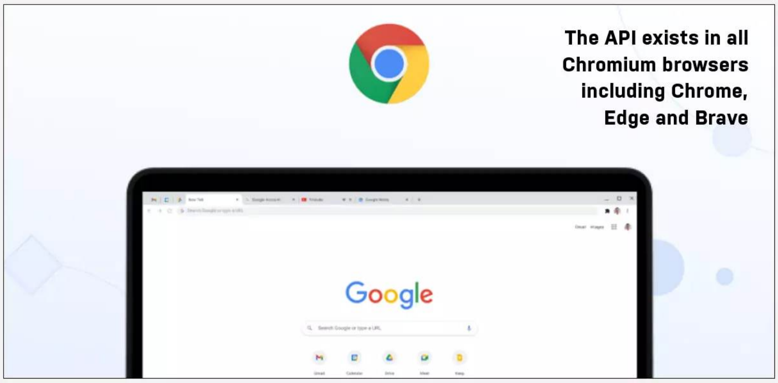
DESPITE BEING THE PREFERRED BROWSER of two thirds of internet users, Google Chrome has had a fairly troubled relationship with user privacy. Earlier this year, the tech giant settled a lawsuit surrounding tracking the internet use of Chrome users, even when using the browser's 'Incognito' mode.

Luca Casonato, the developer of JavaScript Registry (JSR) and Deno, has now uncovered another privacy concern affecting Chrome. The discovery centres on an API provided by the preinstalled extension 'hangout_services', which only Google-related websites can access. This affects any *.google.com domain.

According to Casonato, the data includes access to system/tab CPU, GPU and memory usage, and incorporates a back channel for logging purposes.

Upon further inspection, Casanato found that this issue seems to affect all Chromium-based browsers. These are web browsers that, like Chrome, use the open-source Chromium browser as a code base, such as Edge and Brave.

A Google employee posting on Y Combinator speculated that this was probably designed to optimize the user experience when using Google Meet. However, Google services like Meet work perfectly well in browsers that don't include the API, such as Firefox. **–CL**



The API exists in all Chromium browsers including Chrome, Edge and Brave

Will RISC V make the same mistakes as ARM/x86?

The RISC-V instruction set architecture (ISA) has been gaining popularity due to its customizability.

In an interview on the YouTube channel 'Mastery Learning', Linux creator Linus Torvalds noted the hard differences between hardware and software developers: "There's a fairly big gulf between the Verilog and even the kernel, much less higher up the stack where you are working in what [is] so far away from the hardware that you really have no idea how the hardware works"

Despite RISC-V's popularity, it's not at the performance level of current x86 and ARM CPUs. Torvalds hopes that new architectures like RISC-V will be accepted, even if mistakes are made. **–CL**

WD debuts huge capacity gaming drive

Since 2022, Western Digital's SN850X SSDs has been wowing us. We were particularly amused with a review of the 1TB NVMe SSD, calling it "face-meltingly fast."

This is hardly surprising, as WD acquired SanDIsk in 2016. The company has now released an 8TB version of the WD_BLACK SN850X NVMe. it costs $849.99—with a heatsink, it's $899.99.

According to Western Digital, the drive combines an in-house controller with KIOXIA-sourced 3D TLC NAND flash, and speeds of 7,200 MB/s sequential reads, up to 6,600 MB/s sequential writes, and 1.2 million IOPS 4K random reads/writes. The new drive also comes with a five-year warranty. **–CL**

© CROWDSTRIKE, GOOGLE

Jarred Walton

TECH TALK

AMD details Zen 5 architecture for Ryzen

AMD WILL RELEASE two variants of its Zen 5 architecture into the wild in the next couple of weeks, the desktop 'Granite Ridge' chips with up to 16 cores and the mobile 'Strix Point' processors with up to 12 cores.

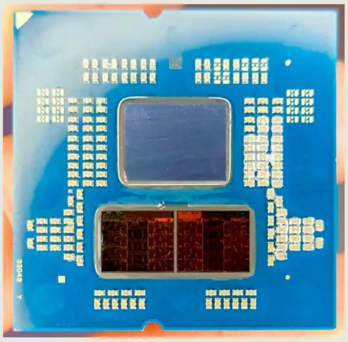
While the underlying architecture for the CPU may be the same, there are plenty of differences between the two families that could significantly impact performance in various workloads.

Granite Ridge desktop CPUs will take over from the Ryzen 7000 series, and work in the same socket AM5 motherboards. AMD plans to launch four different CPUs: Ryzen 9 9950X with 16/32 cores and threads; Ryzen 9 9900X as a 12/24 core part; Ryzen 7 9700X will be an 8-core design with a single CCD (Core Compute Die), and the Ryzen 5 9600X comes with six cores. These follow the existing Zen 4 Ryzen 7000 names—AMD opted to use Ryzen 8000 branding for the Zen 4 G-series parts that come with higher-performance integrated graphics.

Most of the basic specifications look nearly identical when comparing the Zen 4 and Zen 5 variants. The top 9950X, for example, has a 4.3 GHz base clock and 5.7 GHz boost clock, 170W TDP, and 80MB of total L2+L3 cache (16MB L2 and 64MB L3). The 7950X has a 4.5 GHz base clock, while the other specs are the same. But there's a lot more going on than those numbers might suggest.

The biggest changes involve widening the execution engine with a move to an 8-wide design. Zen 4, and all prior Zen architectures have used a 6-wide execution engine. In general, they could fetch, decode, dispatch, execute, and retire up to six instructions per cycle on each Zen 4 core. Zen 5 has a dual 4-wide fetch/decode path with an 8-wide dispatch/retire engine. There are more integer ALUs (Arithmetic Logic Units), six instead of four. There are also four AGUs (Address Generation Units), plus six more ports for vector instructions. Zen 5 also features an improved branch prediction unit with better support for AVX-512 instructions.

AMD's benchmarks show Zen 5 delivering a 16 percent IPC (Instructions Per Cycle) improvement over Zen 4, which will boost performance. In comparison, Zen 4 offered a 13 percent IPC uplift in 2022, Zen 3 delivered a 19 percent gain in 2020, and Zen 2 was a 15 percent increase in 2019, making this is the second largest improvement in IPC for the Zen.



AMD's Zen 5 'Granite Ridge' processors have new CCDs that promise better performance.

AMD has also improved thermal monitoring and TDP, and while the 9950X will have the same 170W TDP as its predecessor, the other chips show substantial decreases. The 9900X drops the TDP to 120W from the 7900X's 170W, and the 9700X and 9600X both come with a 65W TDP compared to 105W on the previous iteration. Those TDP changes don't reduce performance, and AMD says its new 9000 series parts will be anywhere from 11 percent (9700X) to 22 percent (9950X) faster than the 7000 series CPUs.

Strix Point laptop CPUs take a different approach, eschewing chiplets and sticking with a monolithic die. While they have up to 12 CPU cores, only four are the full Zen 5 design; the remaining eight are Zen 5c—density-optimized cores with lower clocks and higher efficiency. They also have significant extras via a second generation XDNA 2 NPU and RDNA 3.5 GPU. The graphics will come with up to 16 compute units—33 percent more than the previous Phoenix Point and Hawk Point processors. AMD showed up to a 32 percent gain in graphics performance from the GPU. 1080p medium gaming should be viable.

The NPU has the potential for even bigger changes, and AMD will use Ryzen AI branding on the Strix Point chips. These will be the first x86 Copilot+ certified PCs, with up to 50 TOPS (teraOPS) of INT8 compute—triple the NPU performance of the previous generation. XDNA 2 also has Block BF16 support, which provides close to the speed of INT8 with nearly the accuracy of FP16 for AI workloads, without needing quantization.

Zen 5 looks set to provide a good generational improvement for AMD processors. We should have more details and full reviews in the next issue for at least some of the CPU models.

Jarred Walton has been a PC and gaming enthusiast for over 30 years.

THE LIST

THE BEST NVME SSDS IN 2024

SSDS HAVE COME A LONG WAY in the last 12 months, and they're now one of the most diverse product categories out there. Not only do you have the cutting-edge PCIe 5.0 drives pushing sequential performance to the max, but companies are increasingly advancing the PCIe 4.0 platform as well, which touts impeccable price-to-performance ratios and far higher capacities. No matter what your performance, generation, or form factor needs, though, these are the drives to keep an eye out for.

5

www.wdblack.com
WD_BLACK™
SN770M
Western Digital.

WESTERN DIGITAL SN770M 1TB

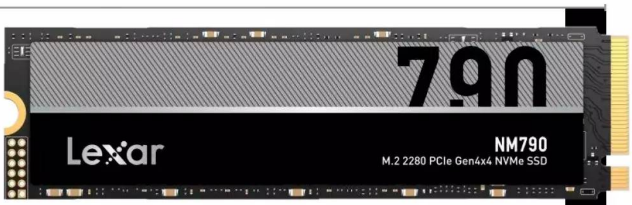
It's undoubtedly the year of the handheld gaming PC, so it wouldn't be a just list without us including the best M.2-2230 drive we've tested to date. WD has paired a Sandisk A1 controller with 112-layer TLC NAND from Kioxia for this one, and although on paper the stats aren't phenomenal (topping out at 5.2 GB/s sequential read, and 267 MB/s random 4K write), for the overall size and form factor, the engineering prowess required to pull this off is nothing short of awe inspiring. It's pricey, though, and really only suited for use in Steam Decks and other handhelds. **$90 www.westerndigital.com**

PCIe 4.0 NVMe M.2
KINGSTON
FURY™
RENEGADE

4

KINGSTON FURY RENEGADE

Arguably picked due to the pure innovation at its heart, the Kingston Fury Renegade PCIe 4.0 SSD is an outstanding combination of impeccably unique hardware. Kingston has paired 176-layer TLC NAND from Micron, with a Phison E18 controller, and a full-fat DDR4 DRAM cache, giving it some serious clout in the performance metrics. It's got the highest random 4K write performance we've recorded, and solid sequential numbers, too. However, that does come at a significant cost increase because of it. **$170 www.kingston.com**



3

LEXAR NM790 2TB

Easily one of the most affordable PCIe 4.0 drives out there—we've seen the 2TB model fall to $110 at its lowest. For that, the NM790 delivers 7GB/s sequentials and random 4K writes topping out at 263 MB/s. It's slower than the T500, and is backed up by a Chinese Maxio MAP1602 controller, and 232-layer YMTC TLC NAND flash, but Lexar's given this a hefty warranty, and the pricing is honestly just too difficult to resist. **$110 www.lexar.com**

crucial®
by Micron
T705
PCIe® Gen5 NVMe™ M.2 SSD

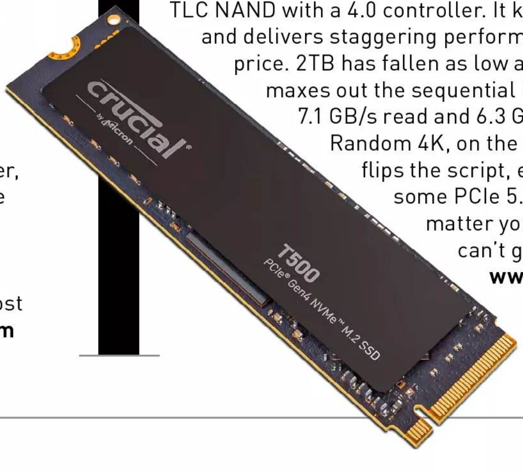
CRUCIAL T705 2TB

This cutting-edge drive takes the hardware now adorning pretty much every PCIe 5.0 SSD, and ramps up the controller to 11. It really does let this drive rip, and sequentials topping out at near 14GB/s are easily achievable. Random 4K performance is solid, too, and the heatsink helps keep it cool under heavy file transfer load. It's not cheap, though, and will set you back twice the cost of a similar capacity T500. **$282 www.crucial.com**

1

CRUCIAL T500 2TB

Consistently our favorite SSD for pretty much every system, Crucial's T500 mixes 232-layer TLC NAND with a 4.0 controller. It keeps cost low and delivers staggering performance for the price. 2TB has fallen as low as $140, and maxes out the sequential bandwidth at 7.1 GB/s read and 6.3 GB/s writes. Random 4K, on the other hand, flips the script, even beating some PCIe 5.0 drives. No matter your system, you can't go wrong. **$139 www.crucial.com**



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Jeremy Laird

TRADE CHAT

Is this Intel's last stand?

I'VE BEEN FOLLOWING Intel for 20 years, and things have never looked this bad. Intel's 13th and 14th Gen desktop CPUs have a serious instability problem, and it's the last thing the company needs as it struggles to turn its chip-manufacturing fabs around and keep up with AMD, Nvidia, and Qualcomm. What's going on, and can Intel survive this latest catastrophe?

When Pat Gelsinger returned to Intel as CEO in 2021, I don't think I was alone in feeling optimistic. At last, there was an engineer in control. Sure, Intel was experiencing something of a lost decade due to complacency over its CPU roadmap and failure at its fabs, but the future looked bright.

As the years tick by, Gelsinger's appointment looks less like a case study in how leadership can save a faltering giant, and more like proof that there's only so much one man can do. It really is difficult to see the positives at Intel right now.

The latest disaster involves Intel's 13th and 14th Gen Raptor Lake CPUs. For a while, there have been murmurings about instability issues. In the last month, it's threatening to be a major crisis. As I write, it's not clear what the problem is. Reports of instability across a wide suite of applications have been reported. Data mined from game developers suggests that all 13th and 14th Gen Raptor Lake desktop CPUs could be prone to these crashes.

If that wasn't bad enough, the weight of opinion seems to be coalescing around the idea that the problem involves the physical properties of the chips, perhaps manufacturing flaws, maybe chip or circuit degradation. Some observers have pointed at Raptor Lake's ring bus, which is the only major architectural change from 12th Gen Alder Lake chips, which do not seem to be impacted.

What's more, Intel has said that mobile chips are not impacted. That is interesting, but mainly because it's pretty much the only thing Intel has said. It hasn't provided an explanation, leaving a void that's being filled with speculation.

> The situation has escalated to the point where it's hard to see how Intel can avoid addressing it directly, and soon

© INTEL

i5
14TH GEN
intel
CORE
UNLOCKED
i9
intel CORE
i9
14TH GEN
intel
CORE
i7
14TH GEN
intel
CORE
UNLOCKED

Crashing desktop chips are the latest chapter in Intel's tale of woe.

A cynical interpretation would be that Intel has been hoping to keep the problem under wraps until the chips were so old that few people cared, and thus avoid a mass recall or compensation scheme. But the situation is now escalating to the point where it's hard to see how Intel can avoid addressing it directly, and soon.

If you look at the timeline for Raptor Lake, it's essentially a pre-Gelsinger product. 13th Gen Core was launched in October 2022, meaning it was conceived and largely developed before Gelsinger's return. Even if the CEO had a hand in developing CPUs, which obviously isn't the case, Raptor Lake was too far gone for Gelsinger to have much impact.

Unfortunately, that isn't going to help much if it turns out Intel has to recall every Raptor Lake chip or compensate every customer. Anyway, while I think it would be a bit catastrophist to claim that these crashing Raptor Lake chips are going to take the company down with them, if Intel fails at some point over the next decade or so, something I do think is a possibility, I suspect this latest episode will be seen as a major event in that process in hindsight.

The reality is that Intel has yet to prove that its chip fabs are back on form, to the extent that more and more of its CPUs are being manufactured by a third party. It's losing market share to AMD in servers, Qualcomm's Snapdragon X chips make Arm technology a real threat in Intel's largest consumer market, laptops, and now its last two generations of desktop CPUs may be broken. Intel has had plenty of ups and downs, but this feels bad. Really bad.

Six raw 4K panels for breakfast, laced with extract of x86... Jeremy Laird eats and breathes PC technology.

DOCTOR

THIS MONTH THE DOCTOR TACKLES…

> Blocked VPN IPs
> Extend Windows 10
> Leave Kaspersky

Malwarebytes & VPNs

Is there any reason why Malwarebytes Anti-Malware Premium flags up—and blocks—IP addresses that appear to be linked to my VPN (Private Internet Access)? Is this some cynical attempt to get me to switch to its own VPN product instead? **—Nicole J Villegas**

THE DOCTOR RESPONDS: There is a long-standing issue between IP addresses used by Private Internet Access and Malwarebytes' real-time protection component. There's little help to be had from Malwarebytes—PIA is flagged as being one of several third-party apps (many of them rival security products) that can cause problems with MBAM's Web Protection, one of its four real-time protection components. Malwarebytes' solution is to disable Web Protection, which results in a frequent nag that it's not enabled. You can turn this off via Settings > Notifications (uncheck 'When real-time protection is turned off'), but that would mean you wouldn't be notified if other components were disabled, something that can happen at boot time.

It's tempting to think that this is cynical behavior on Malwarebytes' part, but the issue is with many of the IP addresses that PIA uses. Make a note of any blocked IP addresses, which can be reviewed directly from MBAM itself: click Detection History and switch to the History tab, and you'll see a list of IP addresses labeled as 'compromised'. Paste these into the AbuseIPDB website (www.abuseipdb.com), and you'll see that many have been reported for abuse, some more than others. You may find these IP addresses are blocked elsewhere on your system—check your router's logs.

This isn't an indication that PIA is unsafe or has been compromised—these are servers that your encrypted VPN traffic passes through en route to its destination, designed to mask your location so your data isn't compromised. PIA can still function by trying different IP addresses until it finds one that hasn't been blocked by MBAM, but it's still annoying.

While you can't prevent MBAM from blocking these IP addresses, you can suppress the pop-up notifications without compromising your security through a workaround involving its Play mode. Ostensibly for gaming, you can use it to suspend notifications and updates when PIA is running. To do this, return to Settings > Notifications, scroll down, and click the Configure link under Play mode. Click 'Add Item', browse to C:\Program Files\Private Internet Access, and choose pia-service.exe. Once added, you'll no longer see the pop-up notifications. Don't worry, though—the IP addresses will continue to be blocked and logged, so you can review them under Detection History, should you wish to do so.

Stay of execution

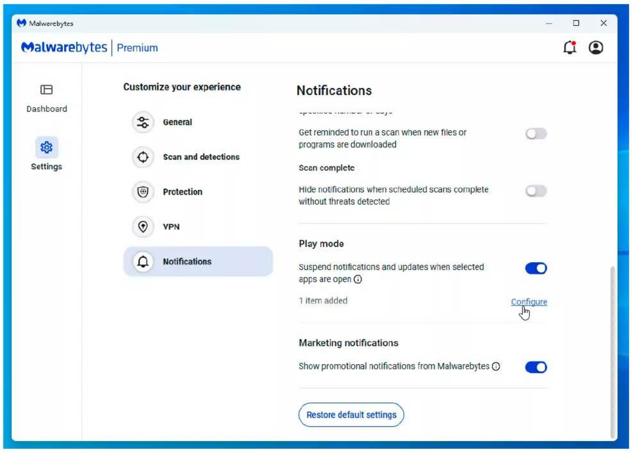
I'm currently running Windows 10, having dabbled with—and rejected—Windows 11. Microsoft is spamming me almost daily with prompts to upgrade to Windows 11 and reminding me that support will end in October 2025. I recently switched my four-year-old mobile phone from Android to e/OS to avoid being left high and dry when support ends. Is there something similar for Windows? **—Harold C Torrez**

THE DOCTOR RESPONDS: While Microsoft plans to provide Extended Security Updates to Windows 10 users for up to three years after October 2025, it won't be free. While educational institutions will be asked to pay $7 per machine for three years, commercial organizations will be charged $61 in year one, $122 in year two, and $244 for the final year of updates—again, per machine. Expect to pay somewhere in between to keep Windows 10 updated.

The good news is that there is an alternative that will cost significantly less in the form of 0patch (https://0patch.com). It has a long history of supporting older versions of Windows with security patches after Microsoft abandoned them, and recently announced it will 'security-adopt' Windows 10 when official support ends for around $27 + tax per year for each Windows 10 PC you own.

0patch promises a minimum of five further years of support for Windows 10. Its main offerings are so-called 'micropatches' that will patch any vulnerabilities discovered after October 2025. Most are so small

↘ submit your questions to: doctor@maximumpc.com


Malwarebytes

Malwarebytes | Premium

Dashboard

Settings

Customize your experience

General

Scan and detections

Protection

VPN

Notifications

Notifications

Get reminded to run a scan when new files or programs are downloaded ○

Scan complete

Hide notifications when scheduled scans complete without threats detected ○

Play mode

Suspend notifications and updates when selected apps are open ⓘ ●

1 item added Configure

Marketing notifications

Show promotional notifications from Malwarebytes ⓘ ●

Restore default settings

Use Play mode to suppress unnecessary notifications.

they'll be installed silently in the background with no reboot required, but that's not all—0patch comes with zero-day patches for known vulnerabilities not yet officially patched, 'wontfix' patches for vulnerabilities the vendor won't patch, and occasional non-Microsoft security patches for popular software, like Java runtime, Adobe Reader, and 7-Zip.

You can set up a free account at https://central.0patch.com and download the free version of 0patch Agent, which offers zero-day patches for free. Request a trial of the Pro version to verify it meets your needs before purchasing a license to continue protecting your Windows 10 PC even after Microsoft abandons it.

Nextcloud update failure

I recently set up a Nextcloud pod in Podman. I received a notification to update, which I did, but it appeared that Nextcloud was stuck in maintenance mode, so I went into the config.php file and switched 'maintenance' from true to false before refreshing the page. However, instead of the latest version , I see the message: 'Please use the command line updater because updating via browser is disabled in your config.php.' Have I borked my install?

—Robert G Ramsey

THE DOCTOR RESPONDS: Thankfully, no. You can run commands on your containers via the podman command itself—and in the case of updating Nextcloud in this way, simply enter the following command at the Terminal:

```
podman exec --user 1000
nextcloud php occ upgrade
```

You may need to adapt the --user 1000 flag based on what user account the Nextcloud pod is running under. In Debian and Ubuntu installations, 1000 is typically your own user account (you can also get this ID via the cockpit web interface under the Accounts tab). If, for any reason, you ran Nextcloud under a different user account, change 1000 to match that user. If you're not sure, check the command you used to create the original pod, in particular the following line:

```
 --userns keep-
id:uid=1000,gid=1000 \
```

The UID here is the number you need to apply to the --user flag. Once the command is applied, refresh the page, and you should find that your Nextcloud instance has completed its update.

Visit the Administration settings of your install through the web interface. If you see a warning message about missing indices, return to the Terminal and issue the following command (again, change user 1000 if necessary to match the user running the Nextcloud pod):

```
podman exec --user 1000
nextcloud php occ db:add-
missing-indices
```

Kaspersky switch question

The US government's banning of Kaspersky has left me in a quandary: I have four PCs protected by Kaspersky. I will have to migrate to another security product by September 29, but which should I choose? And what steps can I perform to migrate across my settings from Kaspersky to another product?

—Joseph S Ford

THE DOCTOR RESPONDS: The Doc uses Bitdefender Total Security to protect his household devices, but Norton 360 and Avast One are also recommended by our sister site, TechRadar (www.techradar.com). There's an argument that the security provided by Windows' Defender is sufficient, but things are more complicated than that—most paid-for products offer additional levels of security, from more configurable firewalls that monitor outbound traffic in addition to traffic coming from the internet, to more proactive protections against ransomware.

Security software is your last line of defense, and in many cases it's your behavior online that will determine how much at risk you are, and what level of protection you need. The Doc suggests you garner opinion about security software from a range of sources and focus on your needs. Also, keep an eye on each product's performance at recognized testing labs that provide quarterly updates. Two to focus on are AV-Labs (www.av-test.org)—particularly its Protection score—and AV-Comparatives (www.av-comparatives.org/consumer).

Sadly, the Doc's not aware of any way to migrate rules from one product to another—he recommends going through your preferences, documenting custom settings and rules with descriptive notes you can consult when setting up your new security package.

Remote backup alternative

I remember a program called Buddy Backup, which allowed you to trade spare backup capacity on your computer with a remote friend for secure backups. I recently tried to find the program, only to find it's been discontinued. Can you recommend any alternative?

—James S Smith

THE DOCTOR RESPONDS: Sadly, we've not come across anything as elegant as Buddy Backup that's both free and allows you to configure your backup and connect to your friend via a single program. Other options, such as Duplicati or Kopia (https://kopia.io) require both you and your friend to configure an SFTP or SSH server independently.

There is a workaround, however. If you dig out the July 2024 issue, you'll see we recommend using Syncthing with other backup tools. This is the simplest option, because Syncthing's peer-to-peer network requires zero configuration. We recommend backing up using your existing tool, choosing any options to compress and encrypt the backup for performance and security reasons, then add a new folder in Syncthing, following the instructions in the backup feature to sync the backup directory to your friend's storage. They should do the same with their own backup directory.

Alternatively, if you and your friend both have the same brand of NAS, explore native options that support remote NAS-to-NAS backups, like Hybrid Backup Sync 3 for QNAP or Hyper Backup for Synology. ⏻

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INGREDIENTS

PART		PRICE
CPU	Intel Core i9-13900K	$400
Mobo	Asus ROG Maximus Z790 Hero BTF ATX	$691
CPU Cooler	Asus ROG STRIX LC III ARGB 360mm AIO	$235
RAM	32GB (2x16GB) Corsair Dominator Titanium DDR5 @ 7,200 MT/s	$200
SSD 1	2TB Seagate FireCuda 540 M.2 PCIe 5.0 SSD	$310
SSD 2	2TB Crucial P5 Plus W/Heatsink M.2 PCIe 4.0 SSD	$158
GPU	Asus ROG Strix GeForce RTX 4090 BTF OC Edition	$2,000*
Case	ASUS ROG Hyperion GR701 BTF Edition	$530
PSU	1200W Asus ROG Thor P2 Gaming 80+ Platinum	$297
TOTAL		$4,821

PRICES CORRECT AT THE TIME OF PUBLICATION. *PRICE IS FOR NON-BTF VARIANT

BUILDING TOMORROW TODAY: OLD SCHOOL VERSUS NEW

BUILT & TESTED
Step-By-Step Guide
PG. 22

Building our first BTF form factor PC.

WE ALL KNOW that PC building at its core is effectively a giant puzzle filled with pieces painstakingly placed into position, to create a product that's far greater than the sum of its parts.

It's not been an easy road to get to where we are today—it's one filled with broken form factors, product lines, building ideas, and companies littering its history. There have certainly been all manner of failings in that time, but there have also been a huge number of successes. Form factors and chassis design features have become permanent fixtures. Still, how we build today, how cases are manufactured and designed to accommodate that process, and how systems are forged, is radically different to what it was even 10 years ago.

So when a number of manufacturers came to the fore with a revolutionary alternative method to PC building called BTF, many of us, this journalist included, initially batted it off as another tech demo; a CES or Computex debut, not to be seen again for another five years.

In essence, this new form factor positions the vast majority of power ports, cable headers, and connectors on the rear of the board itself. This means that you can effectively hide all of your cables in the rear of your case, keeping the front of your build immaculate, as that's what's on display the most. This effectively makes cable management at least appear like a thing of the past.

That does require some serious hardware adjustments, however. Case manufacturers in particular need to re-adjust motherboard trays, motherboard dimensions need to be solidified and etched in stone, and ports positioned.

Is it all just a hype train, or a radically new way forward? Is this the future, or a misstep to the side? We reached out to Asus, champions of this new form factor, to get our hands on some of the latest and greatest kit they had available to really put BTF to the test, and of course, answer the question: should your next build be BTF or not? **–ZAK STOREY**

https://content.jwplatform.com/videos/7COWwnTH-u2lN49He.mp4
Please type this URL into your browser if the link is broken

SO MUCH MONEY

INTEL CORE™ i9
i9-13900K
SRL4H
V134I690 e4

CPU

INTEL CORE I9-13900K

It might be a slightly older processor compared to Intel's current ranks, but the 13900K represents phenomenally good value right now. You can actually pick one of these up for just $400. That's an incredible price, particularly as it delivers performance close to, if not on par, with the 14900K.

At its heart, you get eight performance cores, 16 efficient cores, and a total of 32 threads, with a maximum turbo frequency of 5.8GHz at full tilt. All of that is backed up by 36MB of smart cache, and a 253W TDP.

The 14900K does have a slight edge in clock speeds, topping out at 6GHz, but otherwise, it pretty much operates in the same manner, albeit the 14th gen does have access to Intel's (as of now, still underwhelming) APO, and some AI overclocking tweaks in XTU, but that's about it. Oh, and it comes in at over $147 more at time of writing. ***$400, www.intel.com***

Motherboard

ASUS ROG MAXIMUS Z790 HERO BTF ATX

The first piece of our puzzle, Asus's ROG Maximus Z790 Hero BTF, is very much like its non-BTF counterpart. In fact, the only major difference here is that the connectors are almost all exclusively on the rear of the board itself.

That said, it's still an impressive Z790 board. It can support up to five M.2 slots: four at PCIe 4.0 and one at 5.0. There's support for PCIe 5.0 GPUs, a 20+1+2 VRM solution, DDR5 support up to 192GB at horrendously high speeds, and it's got a stellar IO, with two thunderbolt ports, 2.5Gb Ethernet, no less than 10 USB Type A ports—six of which are capable of 10 Gbps—and WiFi 7 as well. Seriously, this might be one of the most expansive motherboard I/O setups we've seen to date.

There's one caveat to all of that, though: the price, and hot damn is it high—$691 high, in fact. This certainly isn't a good value system, that's for sure. *$691, www.asus.com*

MAXIMUS HERO
SUPREMEFX
REPUBLIC OF GAMERS

CPU Cooler

ASUS ROG STRIX LC III ARGB LCD 360MM AIO

To keep that Intel Core i9-13900K chilled and firing on all of its cylinders, we've opted for something a little special here. Well, if we're honest, Asus offered it to us, and we said, "heck yes". This is an unreleased product that's effectively an updated variant of the ROG Strix LC III ARGB. Now, you can buy the standard version today for $235, but the LCD version we've got here has yet to make its way to market (although we've been informed that it's on the way).

It's a slick-looking cooler too in this 360mm number, and features a rotatable magnetic LCD display that makes it super easy to adjust. It also comes with some potent 3.92mm H2O static pressure RGB fans, and decent socket compatibility, too. The only downside? Well, those chunky cables will be visible, which is kind of at odds with the ethos of this build. *$235*, www.asus.com*

RAM

32GB (2X16GB) CORSAIR DOMINATOR TITANIUM DDR5 @ 7,200 MT/S

It wouldn't be a super-premium build without a set of ridiculously overkill DDR5 sticks to slap in it now, would it? We've fallen back on our trusty old faithful kit of Dominator Titanium @ 7,200 MT/s to fit the bill. These are some of the quickest 16GB sticks out there, and come in with a real-world latency of under 10 ns, too, really helping to keep things zipping along nicely.

The design is exceptional, the RGB light outstanding, and Corsair's iCUE software suite fairly robust these days, too. In an ideal world, we'd have loved to get an additional 32GB of dedicated RAM in here as well, but they're not quite at the speeds we want just yet. You can actually get a similar specced kit at 48GB if you're on the hunt for a little more capacity, however, although your mileage may vary with motherboard certification and compatibility.
$200, www.corsair.com

BUILT & TESTED
Step-By-Step Guide
PG. 22

PRICES CORRECT AT THE TIME OF PUBLICATION. *PRICE IS FOR NON-BTF VARIANT

GPU

ASUS ROG STRIX GEFORCE RTX 4090 BTF OC EDITION

Another unreleased product, this time in the form of the RTX 4090 BTF Edition from Asus. Theoretically, you don't need this specific card (or any BTF card) in a BTF build, but we figured that as we were here, and Asus has its special power connector, let's take advantage of that.

There's no power connector, no 12VHPWR cable to run through the case, and no need to worry about plugging it in incorrectly—just a slot in the bottom ready to run power through. Needless to say, we're fans.

Aside from that, this is your typical RTX 4090, complete with third generation ray tracing cores, 24GB of GDDR6X VRAM, a phenomenal 2,640 MHz boost clock, and enough pure rasterization grunt to render an elephant dancing on your screen 240 times a second at 4K... probably. It's the best of the best, and that's the truth. *$1,999*, www.asus.com*

GEFORCE RTX
REPUBLIC OF GAMERS

SSD 1

2TB SEAGATE FIRECUDA 540 M.2 PCIE 5.0 SSD

She might not be the quickest PCIe 5.0 SSD on the block (that title's reserved solely for the Crucial T705 to date), but Seagate will be darned if it doesn't have the best warranty and recovery package set alongside its top-tier drive.

This thing comes with a phenomenal 2,000 TBW mean time to failure, meaning you could theoretically write 1TB a day, every day, for five years, before the drive itself fails. Combine that with Seagate's Rescue Data Recovery Services, where Seagate will do their darndest to try and save any data on the drive that's been damaged by natural disasters or worse, and it quickly becomes one of the most robust SSDs out there with a recovery package to match.

It's not without its perks on the hardware front, either. It still rips along at 10GB/s on sequentials, and has some impressive random 4K performance to back it all up, too. *$310, www.seagate.com*

PSU

1200W ASUS ROG THOR P2 GAMING 80+ PLATINUM

Last but not least, we come to the PSU. Unsurprisingly, this is a rig that's going to draw a lot of juice from the wall—by our calculations around 840W under full load. To that end, we've also picked up Asus's ROG Thor P2 Gaming 80+ platinum modular power supply.

It's built to supply some serious power to anything you can throw at it, and comes with an armada of cables and an on-board display showing wattage drawn, RGB lighting that syncs with the rest of the case (because of course it does), plus that Platinum efficiency. We'll be scooting under 80 percent of total headroom under heavy load, but that makes this just right for what we're aiming to do here. *$297, www.asus.com*

REPUBLIC OF GAMERS
THOR
CPU / VGA / PCI-E
MB

BUILT & TESTED
Step-By-Step Guide
PG. 22

SSD 2

2TB CRUCIAL P5 PLUS W/HEATSINK M.2 PCIE 4.0 SSD

Another Crucial drive makes the round this month. For our secondary storage, we've gone with the P5 Plus. It was brought to market predominantly for the PlayStation 5's expandable M.2 storage, but it's still more than capable of forming a fantastic secondary drive for any modern-day system, too.

At 2TB, it's remarkably cheap, comes with its own heatsink (that you can remove, which we did), and boasts some top-tier PCIe 4.0 performance, with speeds topping out at 6.6 GB/s. It's not quite as zippy as the T500 or Lexar's NM790, but it's hard to beat from a pure value perspective.

One thing to note: the heatsink and non-heatsink variants fluctuate in price all the time, with the two trading places on which is cheapest. So, if you've got an integrated heatsink, grab whichever saves you the most cash. *$158, www.crucial.com.com*

crucial
by Micron
P5 Plus
PCIe® Gen4 NVMe™ M.2 SSD
FIRECUDA™
540 Series
PCIe Gen5 SSD
EAGATE

Case

ASUS ROG HYPERION GR701 BTF EDITION

With any BTF build, the chassis is going to be a big consideration. Not only does it need to have BTF support as standard, but it's also going to need a ton of cable management support. Similarly, at the time of writing, the GR701 BTF Edition has yet to land on sale, but if it's priced anything like its stock counterpart, it's going to be a costly affair, that's for sure.

That said, it's nothing if not remarkable, with phenomenal liquid-cooling support, an impressive front I/O, and some serious premium touches that take this a step above the rest. There's RGB light panels, aluminum panels and handles, and of course, that awesome styling as well. This is otherworldly. *$530*, www.asus.com*

PRICES CORRECT AT THE TIME OF PUBLICATION. *PRICE IS FOR NON-BTF VARIANT

BLOOD & STEEL

REPUBLIC OF GAMERS

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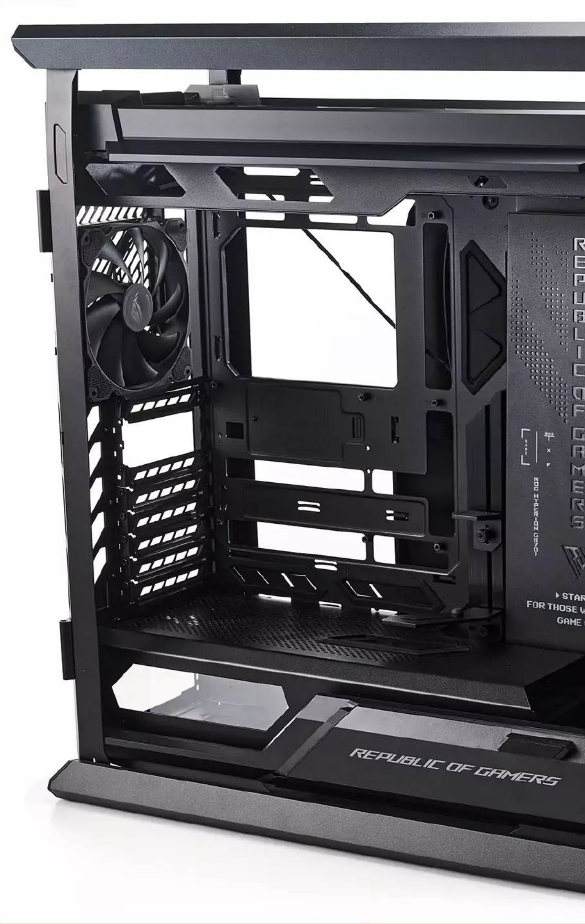

LENGTH OF TIME: 2-3 hours
DIFFICULTY: Hard

We'll admit, there's no small amount of apprehension when it comes to building a system like this. Not only is it remarkably expensive, as good as $5,000 worth of hardware sat in a giant metal box that weighs more than some humans, but, given the very nature of it, with an entirely new form factor and style of build, it puts us on edge. What are we going to see? How different will it be? Will we be able to do it at all? Is something going to go wrong?

That might sound ridiculous coming from this writer, who has several hundred custom PC builds to his name, but there's pressure to make sure we get this right for you fine people. To that end, we actually asked Asus to ship this entire system to us, pre-built, put together by their experts, first and foremost. This was so we could get an understanding of BTF, and how it really fits together, before ripping it out entirely and rebuilding it the *Maximum PC* way. That gave us the opportunity to effectively build it twice, and let's be clear, the way Asus built it (or their PR staff, anyway) is remarkably different to how we approached it.

On the surface, there's a lot of new experiences here, not just with the hardware at hand and its BTF form factor, but also with the chassis itself. It's not a cheap thing, and because of that, it's radically different to anything we've worked with recently. This is a flagship case designed for liquid-cooled masterpieces, and at the price, the feature set is deep and immensely complicated. It's similar in many ways to the Phanteks Enthoo Elite that we used as the basis for a Dream Machine in back in 2017.

It has its own gimmicks, tricks, hidden panels, and more that you need to consider and work around; cables that need routing and powering. All of this adds to the complexity of it. The Hyperion case is a monster, without a doubt. It's phenomenally large, and exceptionally heavy, particularly with those aluminum grab handles adorning the top, bottom, and front. Combine that with the $4,200 worth of hardware sitting inside it, and it's a daunting task. Still, enough of the chit-chat—let's face the fear and dive into this behemoth.

BACK TO FRONT

No matter the build, complexity, cost, or purpose, our first step will almost always remain the same: the chassis stripdown. Yep, the Hyperion may be a beast, but it's got a lot in it that makes it quite simple to strip down to its bare bones with relative ease, albeit with maybe one exception.

The two side windows are attached with magnets (it would have been nice to be able to secure those for transit, like you can with the Phanteks Evolv X, but to be fair, the box and internal packing is pretty robust). Open them up wide, and lift them off the hinges, then set them

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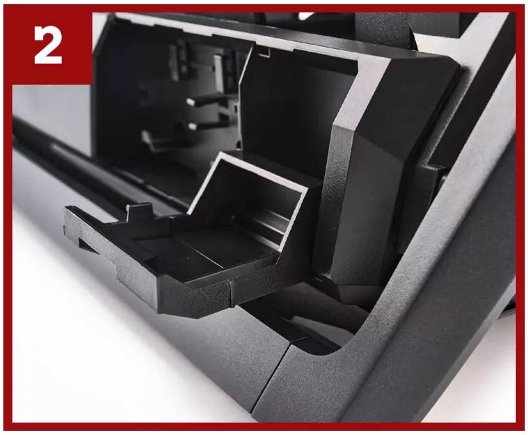

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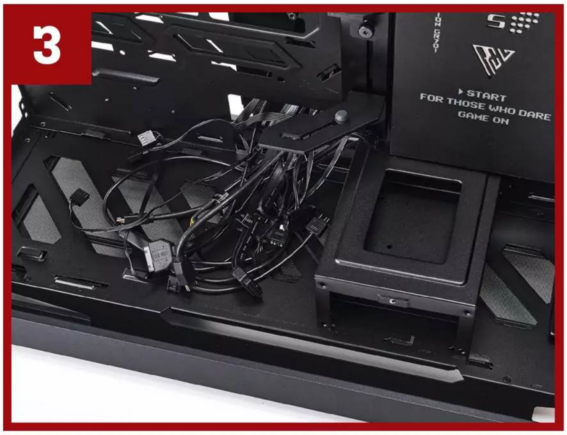

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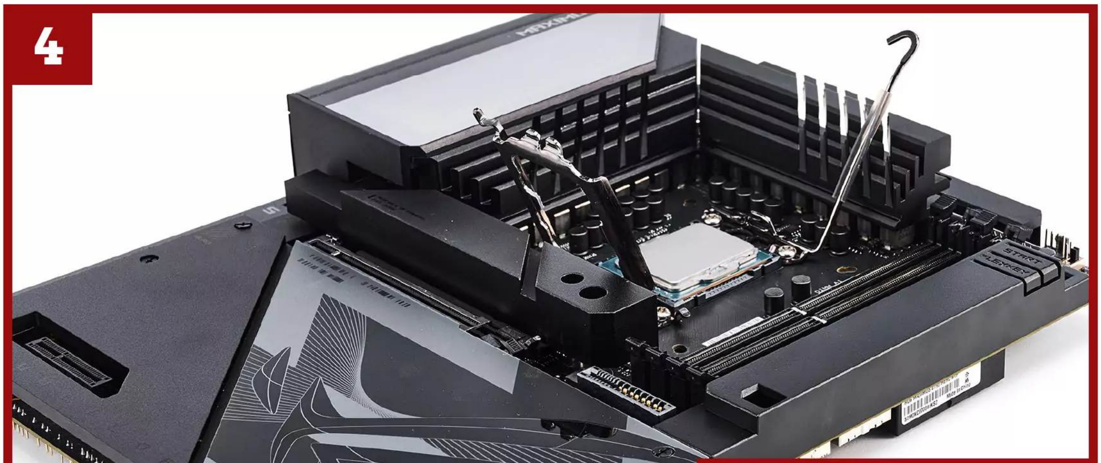

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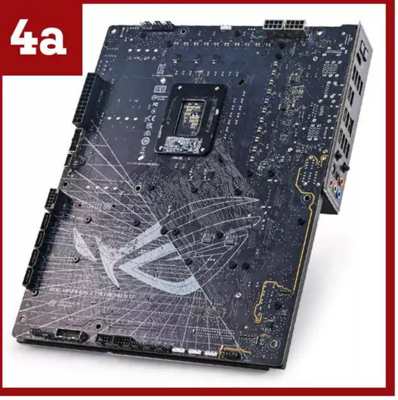


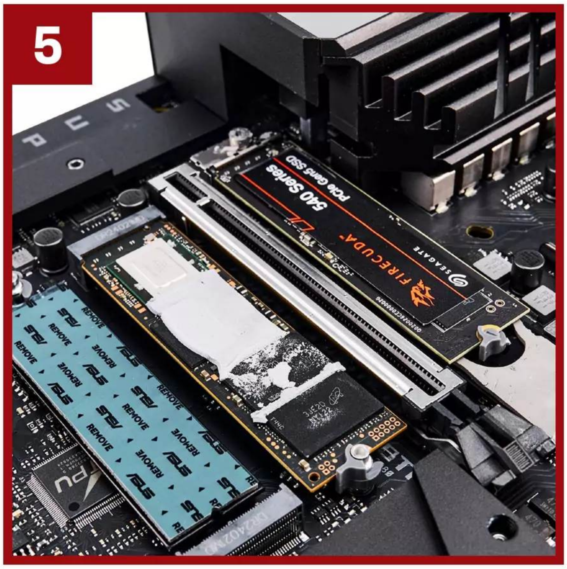
aside for later. Then there's the roof panel hiding the radiator—you can slide that cover back and out easily enough. The front, however, remains attached. It has a multitude of sliding magnetic dust filters angled inward, and that's about it. There's a removable radiator bracket here that currently fits all the fans, but you'll need to lift the entire power supply cover out of the case first (more on that shortly). But with that initial burst out of the way, you'll shed some serious weight from this beast [**Image 1**]. There's also a cable cover tray door in the rear that similarly secures with two screws, and operates on a hinge. Likewise, loosen those screws, and again, open it wide, and lift off the panel to proceed.

Moving onward and upward, next up on the agenda is that power supply shroud. To install your PSU, you actually have to remove the entire shroud. There's no way to just slide the unit in via the rear, or the back panel near the motherboard tray or the cable management area. To do that, you first have to slide the right-most panel on the PSU cover all the way over to the left at the front of the case, then unlock this little tab here [**Image 2**]. It clips in at the top, and is hinged, so push that clip down, and you'll be able to pull it out. Once done, you can then remove a single screw here, along with one to the left of it (hidden underneath where that sliding plastic bracket was).

With that done, you can then lift the entire shroud out of the case, giving you access to everything underneath, ready for power supply installation [**Image 3**]. If you've just looked at that image, and immediately panicked because you've spotted about 30 cables, you're entirely right to do so; there's a lot of them. Not only is the front I/O vast (very reminiscent of older 2010 cases), but there's also some serious RGB lighting on the case, with light strips in the front, and an illuminated display side panel in the case. Combine that with four included fans to manage as well, and, well, you get the idea.

MOTHERBOARD PREP... OUCH!

New form factors mean new ways of hurting yourself, as we found out here. What you would usually do to prep the motherboard is place it on its packing box, and then installing your components from there. Here's the thing, though: because it's BTF, almost all of your connections and headers are now situated on the back of the motherboard, rather than the front [**Image 4a**] (there's one CPU fan header in its usual position, and that's about it). What you don't want to do is what we did, which was just wantonly grab the board like you normally would out of the box, 5



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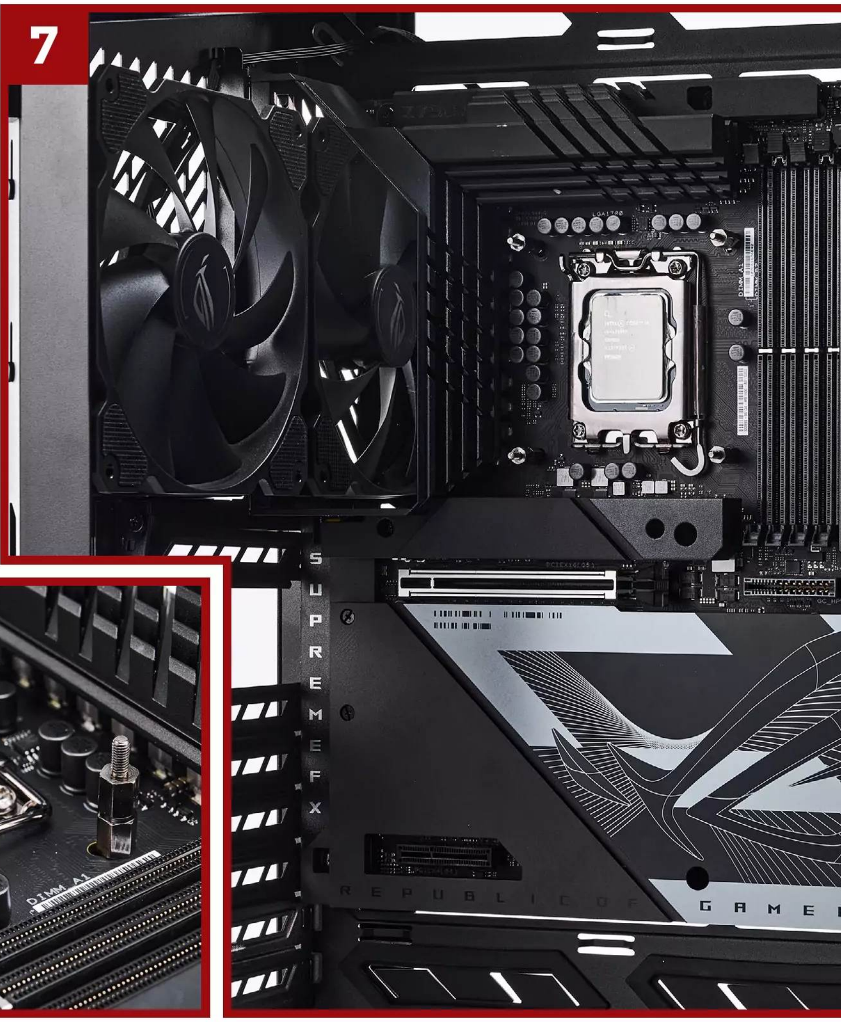

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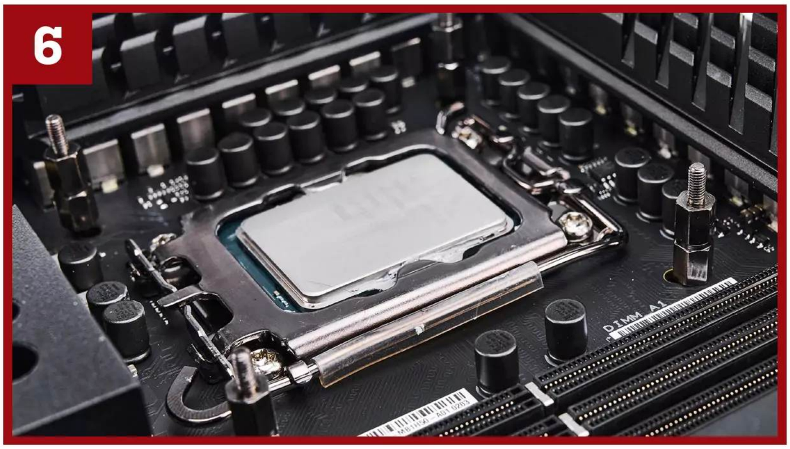

because you've got all manner of spikey headers and sharp points to dig into your fingers when you do it.

It's also hilariously fun to photograph for product shots, as we now have to lean it up against a tape-covered brick (a rare glimpse into our photo studio magic) with its headers resting on that [**Image 4**]. We've also gone ahead and installed the CPU here. To do that, lift the retention arm to the side and up, then carefully remove the CPU socket bracket. Then, making sure you align your CPU with the gold triangles, gently place your chip into the socket. Once in, give it a little wiggle with your index finger to make sure it's secure, then place the bracket back into position and resecure, and you're all good. Scary bit over.

With that out of the way, it's time to move on to our SSDs. The Z790 Hero has a full cover M.2 aluminum block covering the vast majority of the board, and more importantly, every single PCIe M.2 4.0 slot as well. You'll need to loosen the four Philips screws on the block itself to gain access to the PCIe 4.0 slots, and the 5.0 slot has its own dedicated full-fat passive heatsink up top near the CPU itself (again, secured with just two Philips screws). Remove these, take off the plastic film covering the thermal pads for the M.2 slots that you're going to be using, then carefully slide your M.2s into position, making sure you align them with the notches.

They'll stick up in the air by default, so carefully push them down, and latch them into place with Asus's Q-latch. Bear in mind that your secondary drive will need to have its heatsink removed if you're placing it in a PCIe 4.0 slot. In our case, with the P5 Plus, that simply involves removing four tiny Philips screws from the heatsink itself, then carefully removing the drive from its caddy. There may be some additional thermal pads still stuck to the drive, [**Image 5**] but you don't need to worry about that, as they'll compress with the additional pad on top of it.

STANDING TO ATTENTION

We're almost finished with the prep—now it's time to get that AIO cooler's backplate installed. Make sure you get the right bracket from your cooler's bag of accessories, then position the standoff threads into the correct place for your socket. Then, using the correct standoffs, slide the backplate in underneath, through the standoff holes around the motherboard socket, and secure it into place with those standoffs you grabbed earlier on the other side [**Image 6**].

With that out of the way, we can now finally get our motherboard into this massive chassis. Fortunately (unlike last issue), our near-$700 motherboard has an integrated rear I/O backplate, so we don't need to worry too much here. Place your case on its side, line your motherboard up with the standoffs and rear I/O, and carefully place it into position. Usually, the center standoff location is slightly longer and acts as an alignment pin to help position the board, at least in most

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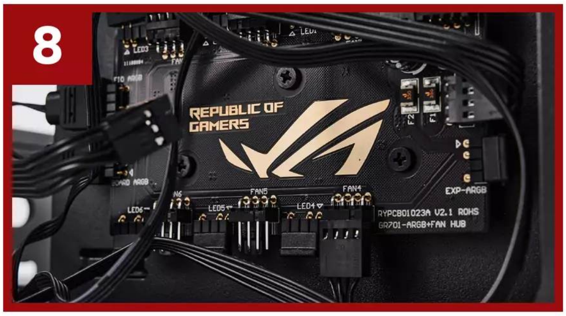

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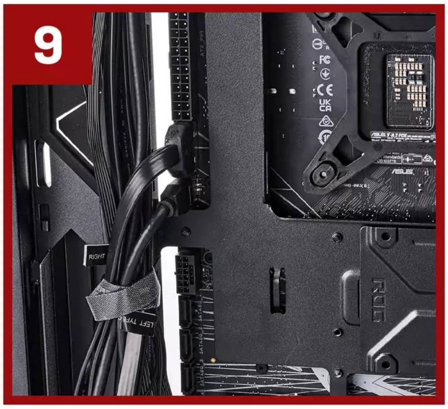

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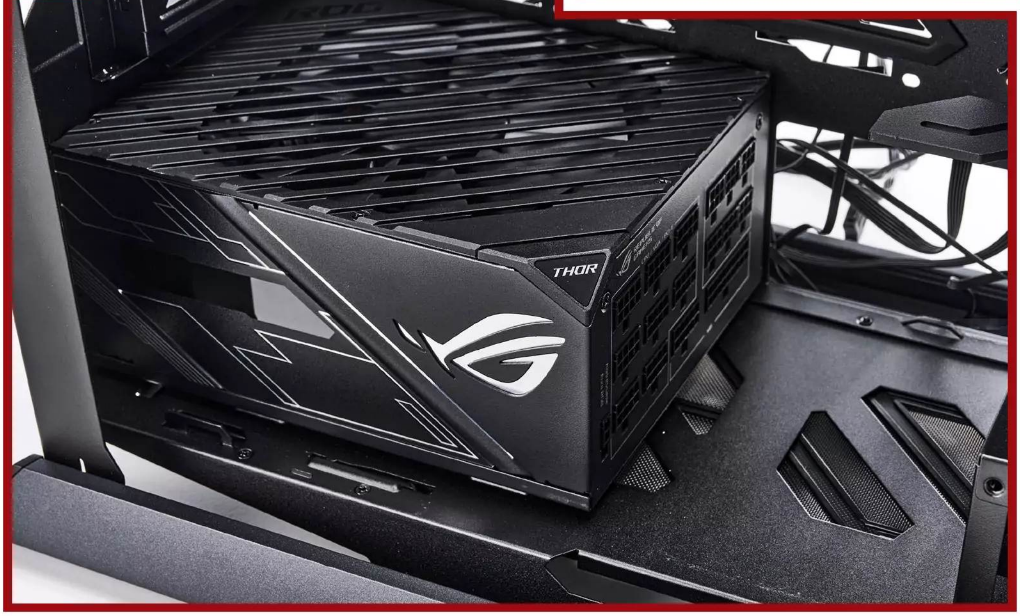

modern cases. Then, it's simply a case of securing it into position using the included screws found in the case accessory box, and you'll be good to go [**Image 7**].

Now, given how many cables there are in this thing, we're going to get a head start right now, and get to cable managing as best we can straight away. Fortunately, Asus includes this phenomenally classy aRGB and fan controller hub in the back of the Hyperion [**Image 8**], and it really does look the part here. We've installed all of the case fans, along with the front panel I/O lighting, and the board ARGB here as well. Interestingly, it also requires two SATA power connectors to manage all of this, and there is, of course, a cable that connects to a USB 2.0 header on the motherboard as well.

AND SO IT BEGINS

So here we go—you'll likely see a lot of shots like this in the mag if BTF takes off. Our first look at the rear of the motherboard tray in a BTF case, along with the ports all lined up and more [**Image 9**], as you can see that a lot of our fears have become manifest. There is some wiggle room for port positioning on motherboards. However, the thin strips of metal holding the rear motherboard tray together doesn't exactly fill us with confidence, particularly when thinking about heavier liquid-cooled systems.

On the plus side, it does make things moderately easier to cable-manage on the fly. We say 'moderately', because unlike in a traditional build, cable management here is everything. Power supply cables remain the same length, and as such, you're going to have to proactively cable manage everything to the very best of your ability, without exception—all to get the side panels to fit. We've preemptively plugged in everything we can (yes, even the front I/O) and wrapped it up as best we could, too, although even this isn't a patch on what it'll eventually look like.

With our cables nicely managed, it's time to get the Thor in here. One of the key frustrations with this power supply is that display; namely, there's only one, and it's on this one side of the unit, meaning that if you want to actually see it in your build, then you have no choice but to install the PSU so the fan faces upward.

It's mildly frustrating, to say the least, particularly as not every case supports this orientation. For instance, if you're a fan of the Phanteks Evolv, you can forget about ever seeing that display, as the PSU cover is an entirely solid block of metal. You'd suffocate that exhaust fan and possibly kill your PSU if you installed it that way.

To install the PSU, place it at the rear of the chassis, then secure it with the included screws from the back, as you would normally [**Image 10**]. At that point, you can then install all the cables you need into the Thor, and route them around the back ready for cable management later. Once that's done, it's a case of replacing that PSU cover in full, too.

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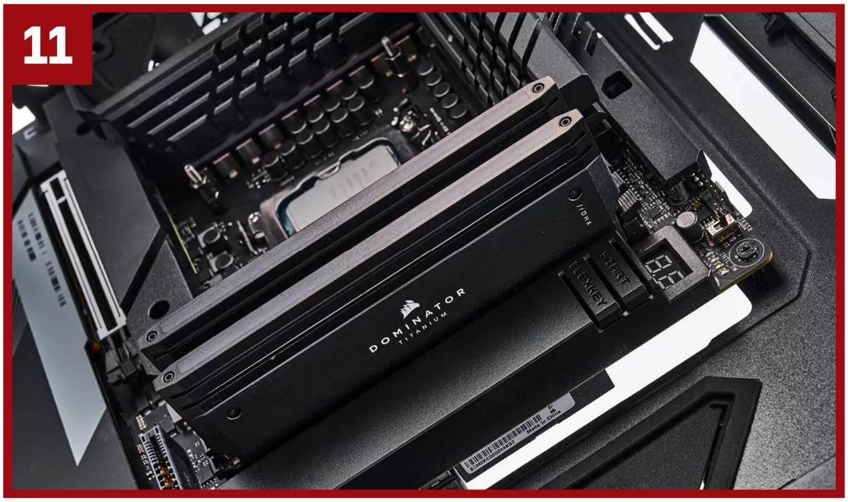

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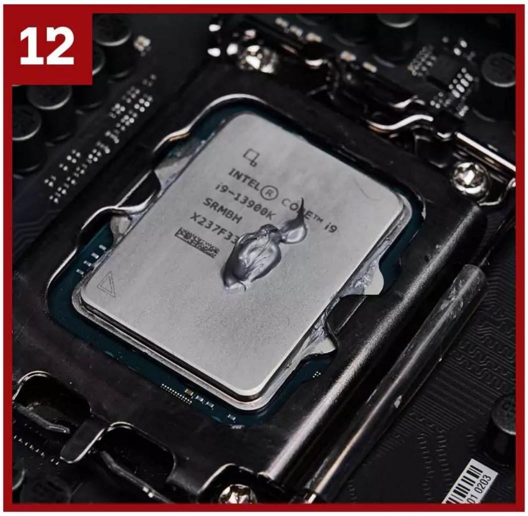

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GEFORCE RTX

SMALL DETAILS

Weirdly, it's at this point that we'd start to recommend getting components installed to avoid the cable management mess you're going to be dealing with in mere moments. Install your CPU EPS power cable now to avoid conflict with the radiator, and so on. But with BTF, you just don't need to worry about that. Build order kind of goes out the window, as there's very little that can cause a conflict with anything on this side of the chassis. Theoretically, you could install your GPU now if you wanted—there's nothing stopping you.

We opted for memory, though, which is nice and simple—lift the latch up at the top, align the DDR5 stick with the notch in the slot, and click it into place with a bit of force, making sure to use every other slot. It's super easy and super quick—just make sure the case is on its side (you can install them with the chassis upright, but it makes it so much easier to apply that pressure if it's laying down). Always make sure your memory is well seated—if it's even fractionally unsecure, your system won't boot. Remember, if a system doesn't boot for you, it's probably memory-related [**Image 11**].

Now, let's talk thermal paste. This [**Image 12**] is how this editor applies thermal paste—a bit haphazardly in the middle. The usual definition most tech journos and media outlets go for is 'a small, pea-sized blob in the middle of your CPU'. We're a little off center, and that's a touch more than a small pea. You can probably also spot the thermal paste littering the sides of the chip from previous installs. Simply put, with a healthy blob in the middle like that, the pressure from the CPU block is going to nicely distribute that evenly across the chip, and probably squeeze a bit out the side, providing plenty of interface between the IHS and the block directly. As long as your thermal paste isn't conductive, and you don't mind a bit of clean-up after if you ever need to remove it, then there's no issues with going overboard, and it won't affect your temperatures either. It's better to have it and not need it, than need it and not have it, to quote George Ellis.

With our thermal paste applied, it's time to get that AIO in. We've done this by first installing the radiator with the case upright, securing it from above into the radiator mount locations, with the included short screws and washers provided. We've also pre-installed the fans to it before that. Typically, we wouldn't do that latter part until our EPS power cables and top-most motherboard connectors were all installed first, but we just don't need to worry about that here. Nonetheless, secure the radiator in place, then move onto your CPU block. Lay the case back down onto its side, and then position the CPU block on to the standoffs. The Asus unit we're using has a removable magnetic LCD display on it that you can attach after the fact, too, making this super easy all in all. Then, with the block in place, secure it down with the included

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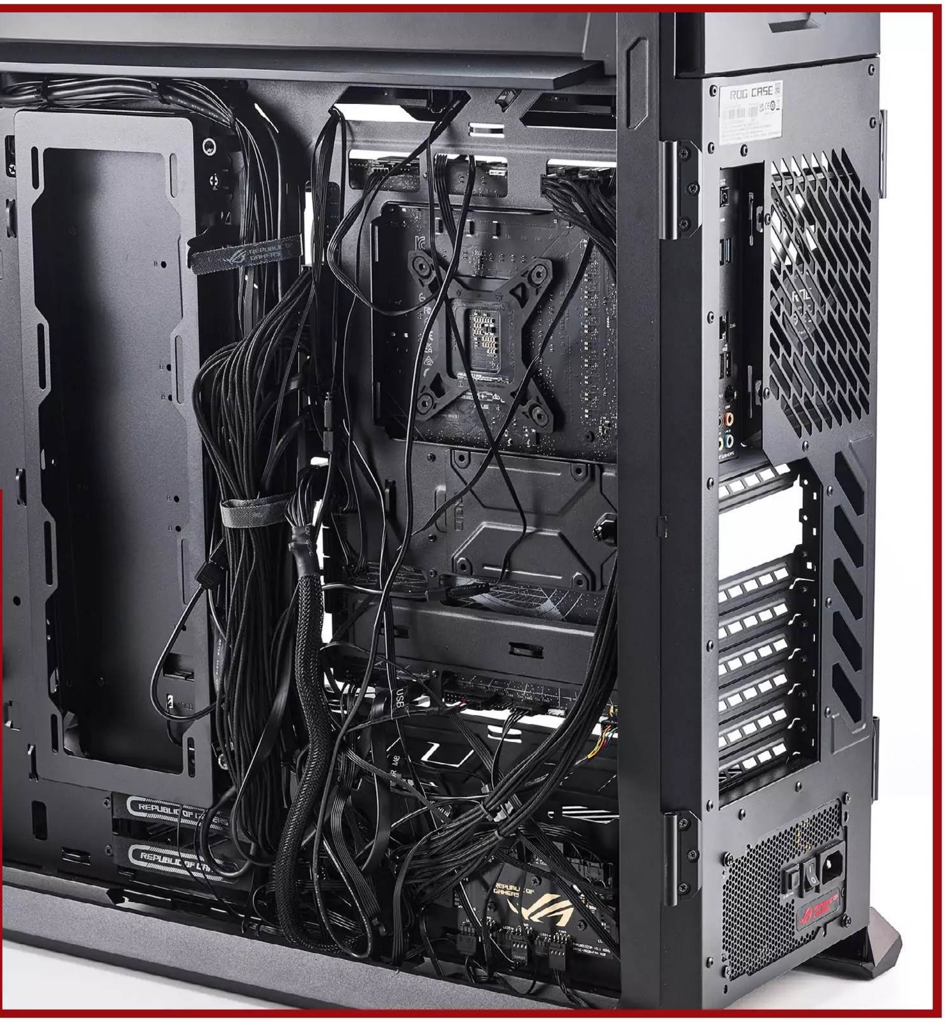


thumb screws in a diagonal pattern. Do this by hand so that you don't over-tighten it [**Image 13**].

SO, SO, MANY CABLES

We're in a very bizarre point in time for custom PC building. On the one hand, you have all manner of manufacturers pouring every ounce of energy into reducing the number of cables required, with daisy-chaining systems, or Corsair's iCUE Link designs as an example. Then you have BTF, which feels like it's doing the opposite.

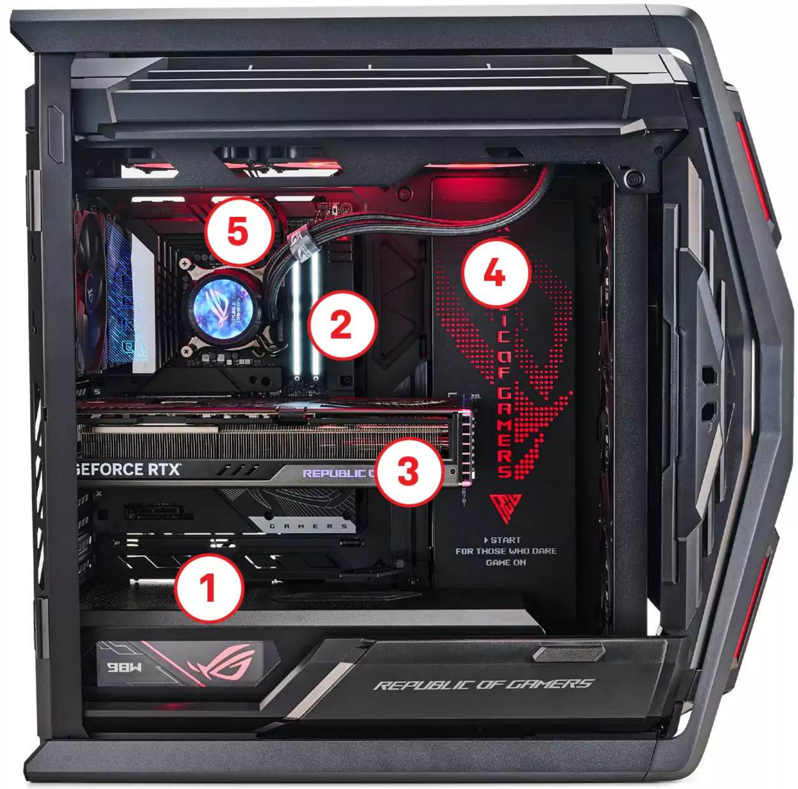
To be fair, this is an extreme example. There are a lot of connectors and cables to manage. Given how little space you have on the back of that motherboard tray, particularly as your ports now take up a lot of space where you would typically tie cables too, there's not a huge amount of room to work with, or to actually tie things down to. There's the odd cable tie point here and there, and the usual velcro straps, but they're fleeting in comparison to what you see on other chassis at far lower price points. Sadly, traditional cable-management routes just weren't obvious. We could have perhaps bundled things together a bit more to make this process a little tidy, hidden cable length under that PSU cover (although we did want to keep the HDD bay in there), but it was still a struggle [**Image 14**].

Here's the thing, though: similar to those first EVs that started popping up from the legacy car makers, rather than companies dedicated to that design, the Hyperion is a retro-fit rather than a bespoke design for BTF. It's a chassis that's been out in the aether for some time now, and wasn't first designed with BTF in mind. So cable-management space and cable management in general, although there, is more suited to a traditional build. The BTF element of it is mostly the extra metal cut out of the backplate [**Image 15**].

Last, but by no means least, we've opted to install the GPU. This might seem odd, given everything we've said here, but we're suckers for consistency. Another faux pas of the Hyperion is how you access its rear PCIe slot screws (yeah, weird complaint). You have to thread a screwdriver through a tiny trapezoid vent-like hole for each, unsecure the screw, then carefully lift it out with said screwdriver, without dropping it anywhere. It's the same for re-installing, too. What a mess.

For our GPU, though, there's one extra consideration—we've now got a single high power 12VHPWR connector to contend with. Right next to the top-most PCIe 5.0 slot is an extra slot for exactly that. It takes a little extra focus, but once your PCIe slot covers are removed, line your GPU up with that and slide everything into position (again with the case on its side). Once the PCIe securing clip clicks into place, you'll know that you're secure, connected and powered up. You can then move one of the GPU anti-sag brackets up into position, and replace all of the panels you removed earlier, and you should be all done [**Image 16**].

HONEY, I LOST THE CABLES



1 Asus, why do you have those bottom rubber cable grommets for cable management if there are no cables to run here?

2 We're finally starting to see four stick kits of RAM land for DDR5, and at reasonable speeds. Boy, do we want to get a 64GB kit in this thing.

3 Even with a GPU anti-sag bracket in place helping to lift this up, we're still getting a touch of droop on the graphics card.

4 You can remove this massive ROG RGB LED panel if you want, and install a radiator or more fans here instead. But we admit, we kind of like it.

5 BTF is very much dependent on all the other components aligning, with coolers not having cables on the CPU block as well.

SO, BTF. Revolutionary new design system? Or should it have been named PITA for experienced system builders? It's a tricky one. On the one hand, at least from the front, this system looks remarkably clean. There are absolutely no cables on show at all, bar the two coming from the CPU block, and to be honest, you could eliminate those if you picked up a decent AIO with the cables running up the tubing, or something similar. We've seen a few of those land out there in the ether already.

It also feels a little odd that Asus chose to include a single fan header at the top of the board. We get it, it's there for short CPU pump cables and such, but you could easily get around that by including a fan cable extender in the motherboard box, and make it even tidier.

The bigger problem by far, though, is the cable management in the rear, or at least how difficult it's now become to manage that. Let's be clear, this is a big issue that's very much dependent on the rest of the ecosystem, and that gives us a touch of worry.

Unless you've got some incredible new cases with awesome cable-management designs coming that allow you to run your cables in a completely different manner, the current stock of PSUs available just have cables that are far too long, and given BTF still (and will) likely only represent a small amount of the market, those long cables are going to be the de facto cables included in even the most expensive of kits. Are you then going to have ask BTF adopters to buy specialized short cable kits as well?

The smart thing to do would be to shift the case design entirely so that instead of having the PSU at the rear of the case, for your BTF chassis, you actually place them at the front, and then move the hard drive caddy to the rear. That would give you the extra distance to give you tighter cable runs, and more breathing room with that cable management.

How you reinforce that backplate though, is another thing entirely. We'd be surprised if we didn't see thicker, more heavy-duty backplates arise as a result of this shift as well. Again, all of this is adding cost, not only in R&D time, but in materials (although arguably you should have lost some of that when you cut out all that metal to begin with).

Even the one cable system that we have available to us isn't enough to negate the disadvantage here, as the vast majority of daisy-chaining systems only eliminate fan and RGB cables, not power cables, USB cables, front panel connectors, and more.

The one key takeaway from all this is that custom 12VHPWR connector. Having that on the board is awesome, and should be a standard, but with an industry-wide form factor behind it that Intel, AMD, and Nvidia use on all of their next generation of cards. The most unsightly thing on modern RTX GPUs from the last two generations is that 12VHPWR connector being slap-bang in the middle. With this, you could easily route it in another direction, plus it adds an additional form of support to the GPU as well, which is nothing if not a benefit. Cards are getting bigger and heavier, and GPU sag becoming more of an issue, so anything we can do to help with that on a basic level should be pursued.

So it's good, and it looks seriously clean (bar that CPU cooler cable), but it's not in any way making it easier to do your build. In fact, it might be a step back, making it mildly more difficult. If you can live with that (and the hefty price tags that are going to trail behind this form factor), then it's a phenomenal advancement. If not, then fortunately we have every other form factor to fall back on, and it doesn't quite look like that's going anywhere just yet.

BENCHMARKS

	ZERO-POINT	
Cinebench R23 Single-Core (Index)	2,094	2,176 (4%)
Cinebench R23 Multi-Core (Index)	34,869	34,135 (-2%)
CrystalDisk QD32 Sequential Read (MB/s)	7,129	10,061 (41%)
CrystalDisk QD32 Sequential Write (MB/s)	6,611	10,157 (54%)
3DMark Fire Strike Ultra (Index)	13,596	24,359 (79%)
Cyberpunk 2077 (fps)	42	75 (79%)
Cyberpunk 2077 RTX (fps)	15	44 (193%)
Metro Exodus (fps)	53	101 (91%)
Metro Exodus RTX (fps)	34	79 (132%)
Total War: Three Kingdoms (fps)	51	102 (100%)
Core Price ($)	$2,329	$3,600 (55%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point consists of the Geometric Future Model 4 cover build from our July 2024 issue. Featuring an Intel Core i9-14900K, AMD Radeon RX 7900 GRE, Asus Z790 Maximus Dark Hero motherboard, 32GB of Corsair Dominator Titanium DDR5 @ 7,200 MT/s, and a 2TB Crucial T700 PCIe 5.0 M.2 SSD. All games tested at 4K "Ultra" graphics presets with DLSS and V-sync turned off, and XMP RAM speed turned on. No manual CPU overclocking. 'Core Price' refers to the key components generating performance (CPU, GPU Mobo, OS SSD, RAM), not accessories.

TITANIC PERFORMANCE

OKAY, we've got the build process wrapped up. What about the performance? What can a $4,821 machine do? Turns out quite a bit. Now, we do want to point out that we have limited this system somewhat. When we installed Windows, we always make a point of updating the BIOS on the motherboard to the latest version (along with installing all the most recent updates and new drivers, etc), to really get the most out of the rig.

Interestingly, however, Intel has finally forced motherboard manufacturers to implement their default Intel settings as standard, and Asus has honored that request as well. If you go into the BIOS after the update, the option is there to enable Asus's Auto AI Overclock mode, or Intel's default settings mode. That means voltages, temperatures, and performance are slightly lower than what we've seen from some of our other builds when it comes to raw CPU performance. We did expect a bit of that, given the CPU is a 13900K not 14900K, and comes with a slightly slower 5.8GHz turbo speed versus 6GHz for the newest kid on the block.

Nonetheless, in practice, that 13900K at stock settings beat the 14900K in single-core performance, besting it by an impressive four percent in Cinebench, but lost in the multi-core test by two percent. Those are interesting details to dig into. We suspect that more stable thermals helped in the single-core test, but the 14900K could maintain higher clock speeds across all its cores for slightly longer in the multi-core test. Again, this is all within margin of error territory, but nonetheless, that's a curious thing to see, particularly given the 14900K was running on its Asus optimized settings.

Similarly, that Seagate beat the T705 in CrystalDiskMark. We're still not quite sure why, given how similar the motherboards are, and we're investigating whether there's an issue with the drive itself, or in the benchmarks for the T705 in that system, but we'll have to get back to you on that. Still, 10GB/s isn't bad at all. It also nailed 90MB/s read and 330MB/s write in the random 4K tests.

When it came to gaming, the RTX 4090 dominated here, too. Its raw grunt and ability to handle Cyberpunk with ray tracing at 4K without DLSS is staggering, 44fps is nothing short of a miracle, given how punishing that game is, and it feels good to see such a high number without the aid of DLSS. Likewise, *Metro Exodus* also landed a sweet 79fps at 4K with ray tracing, and *Total War* at 102fps is a treat. One thing to note: these two zero-point systems are incredibly similar from a spec perspective, with the only major difference being the GPU affecting core price, yet despite a 55 percent increase in core price, we regularly saw frame rates bounce up by, on average, around 112 percent. It's one of the rare occasions where there aren't diminishing returns by investing more cash into your rig.

MAXIMUM PC'S LOVE LETTER TO MANUFACTURERS

BTF IS AN INTERESTING DESIGN DIRECTION, BUT HERE'S WHAT WE REALLY WANT

WE COULD GO on for days about BTF. It's a unique design choice that the vast majority of the industry does seem to be getting behind. The big three—Asus, Gigabyte, and MSI—all have products correlating to the form factor, or are about to release them, including some budget picks as well (both MSI and Gigabyte's BTF boards are B650 products, as an example), and we're hearing rumors from case manufacturers and other partners that they're backing it as well (albeit just by adding compatibility to existing product lines) to test the water.

It's a form factor that's going to live and die on that ecosystem compatibility. As a whole, the tech industry has been relatively good at co-operating with one another over the years—to a degree, at least. There are still significant barriers and competitiveness out there, of course, but sometimes, companies do come together for the greater good to better protect sales and improve the quality of life for us mere mortals. This makes sense; it's hard to introduce a product with a radical new ethos behind it and have it gain market share if no one else supports it with their own components, and that's exactly what we can see here with this build.

The thing is, it needs to be clearly beneficial to all parties. In the case of removing visible cables from the front of your build, that's a win for everyone, as each manufacturer looks for ways to make their systems look more aesthetically pleasing. BTF certainly represents a way of achieving that.

Even in Asus's own ecosystem, and even with the products it has to hand, it can't provide an absolutely clean, zero-cable visible system with its BTF line. You still have that cooler with cables on show, a case that's not really optimized for BTF, RGB fans with way too many connectors, and a power supply with cables near enough a yard long, complicating matters further. Pair it with something like Corsair's iCUE Link tech, though, and all of a sudden, the majority of those foibles disappear.

A WISH LIST

That got us thinking, though. As enthusiast PC builders, and hobbyists, what is it that we actually want? Instead of manufacturers releasing products, and us critiquing them (a very passive way of suggesting change), what can we directly say that would be beneficial for us as the good PC folk we are? That's where we came up with this list.

1. CHOICE

It probably goes without saying, but the biggest thing that makes a case stand out to the *Maximum PC* team is getting to choose how you build your system. There are a number of cases out there right now that sort of inadvertently push you a certain way: the AIO goes in the roof; the GPU has to be vertical; your motherboard can only go here; the PSU can only go in this orientation, and so forth. By far the best cases allow for multiple layouts and setups. Want to install your AIO in the floor or the front? Sure. Want to rotate that PSU sideways, and run a passthrough instead? Go for it. Want to invert your entire system, and flip the motherboard on its head? Go for it. Cases that facilitate that without compromising in other areas are big winners. Add a few colorways to that, and you're golden.

2. FEWER CABLES

This goes without saying at this point, particularly with this build, but fewer cables is a must. We're tired of spending nearly an hour on each build painstakingly figuring out where all these cables go, and how to connect them. One of our recent mid-range builds featured no less than 36 separate cables, just for the fans. That's monstrous—daisy-chaining at a minimum is a must, and you can do it, as we've seen Phanteks manage it with a $30 triple fan kit, or on the top end, single-cable solutions like Corsair's iCUE Link.

© MSI, GIGABYTE

All of the big three motherboard manufacturers are now on board with BTF.

Corsair's on the right track with its iCUE Link system, but why no USB C?

3. BETTER CABLE MANAGEMENT

Just take a look at the Hyperion case in this build. It looks great, has stunning lighting, and awesome cooling potential, but the cable management is actually worse than the Phanteks XT View we reviewed last issue. There are a few velcro straps, sure, but that's it. If BTF is going to become the norm, then cable-management solutions need to become standard at every level. We're talking cable channeling, with velcro straps, perhaps movable and magnetically attached, modular. There needs to be velcro straps everywhere, clear guides and pathways to facilitate it, and better RGB and fan control units. Heck, we have USB Type C as a standard—use it. We don't need Thunderbolt 4 ports littering the thing; just take advantage of a low-spec model to deliver both power and data control at the same time (a better question: why is iCUE Link proprietary when you could have USB C instead?).

4. RGB SOFTWARE THAT WORKS

We're not talking just as standard (as most software, if installed correctly and configured correctly, will work to a lesser extent), but in a broader scheme. I don't want to be locked into your ecosystem. Not everyone's a PR rep, and no one's going to buy every single component from one manufacturer. It's that dynamism and combination of parts that makes PCs as awesome as they have been. What we want is one piece of RGB software that can control every piece of hardware, every peripheral, with ease. No fuss, no conflicts, and with all the advanced features found in the full-sized software. Yes, there's OpenRGB and even Windows 11 dabbled in it for a time, but some actual effort behind it, plus full backing of the industry, could really elevate us to new heights.

5. REVERSIBLE FAN BLADES

Why it took until 2024 for someone to finally release fans with a reversed configuration is beyond us (thank you, Phanteks). Performance and aesthetics shouldn't be something we have to pick and choose between. When you look at a Dodge Challenger SRT or a Porsche 911 GT3 RS, you wouldn't expect half the wheels to be performing worse because they're facing the right way from an aesthetical perspective, would you? No. The same is true of PCs—all manufacturers should have reversible fans, or at least the option to buy a reversed kit. So often, we have to build systems, and then have ugly fan guards on display because we need to use those ones as intakes rather than exhausts, but the back end of them has cables showing, product information stickers on them, or worse. Let's stop with that already.

6. CHEAPER HARDWARE

Why the heck are product lines so darn expensive these days? General laws of production state that as a product becomes easier to manufacture over time, the cost should come down along with it. Transistor tech gets smaller, then it gets easier to mass produce—or it should be, anyway. Admittedly, we're seeing prices fall in some categories—memory being one, but for everything else? It's staying pretty much resolutely the same, particularly motherboards. Price hike generation after generation. Yes, the R&D is getting tougher, but is that seriously what you're using to justify that price increase year-on-year?

Once upon a time, you could build a PC that could rival a current-gen gaming console's performance, or close enough, with a slight increase in cost. Now, there's just no chance, not really, and given the fact that these consoles are effectively running on near enough the same hardware as well, it's a bitter pill to swallow.

TO CONCLUDE

Okay, we're being a bit harsh here; BTF is exciting. It's early days, and like with ray tracing, and even AI to a lesser extent, what we're seeing now is just the tip of the iceberg of what's possible.

If BTF remains the de facto standard moving forward in the way we expect it to over the coming months and years, and the product launches and pricing remain reasonable, then it's likely that PSUs, cases, and everything else in between will catch up as well, and that makes this an exciting time.

Depending on how GPUs develop, too, this could finally put an end to builds with ugly front connectors, and that does make us excited for what we're going to see in the coming months and years from a build perspective. Still, we've got a long way to go until we reach that point, and there are going to be a lot of hurdles to overcome until then. Should your next PC be a BTF build? Honestly, if you can find a stellar case built for it, and shorter cables, then absolutely. But non-BTF is also fine.

© PHANTEKS

NZXT's cable management channels should be the default for these builds, built out in a modular capacity.

We need more reversed fan kits like the D30 Reverse version Phanteks offers.

A.I. SUPREMACY: IS THIS THE DAWN OF A NEW ERA?

Zak Storey takes a dive into the world of artificial intelligence, and everything that currently entails

Oh the big boogeyman, artificial intelligence. We've certainly had enough warnings about it over the years in all forms of pop culture, and early science fiction. But the advent of AI is finally here. Or is it? What is classed as AI? Do we truly have general intelligence yet? And is that even possible?

There's a lot of confusing information out there concerning the current state of artificial intelligence, how far we've come, and where it's heading. There's no small degree of worry, and with good reason. That's no bad way of being with emergent technology, either (if we're honest, it's probably an attitude we should have had with a lot of other tech debuts over the years). Still, there are huge advancements and advantages that AI can deliver to us humans, too. It has the capacity and potential to rapidly accelerate all manner of different fields and discoveries, whether that's healthcare, medicine, technology, engineering, biology, chemistry, or even searching for life in our cosmos; the applications for it are numerous.

The success of AI and what it becomes is entirely dependent on the actions of the actors involved in its development. No matter how you look at it, right now, the AI models that we have are tools: some good, some bad, some exceptional. These are evolving rapidly, but we have the opportunity to steer their direction and push them in a path that's beneficial to everyone, not just a select few.

This month, we decided to take a look at just where we're at with AI: where we're going, what hardware requirements

THE BEST AI TOOLS TODAY

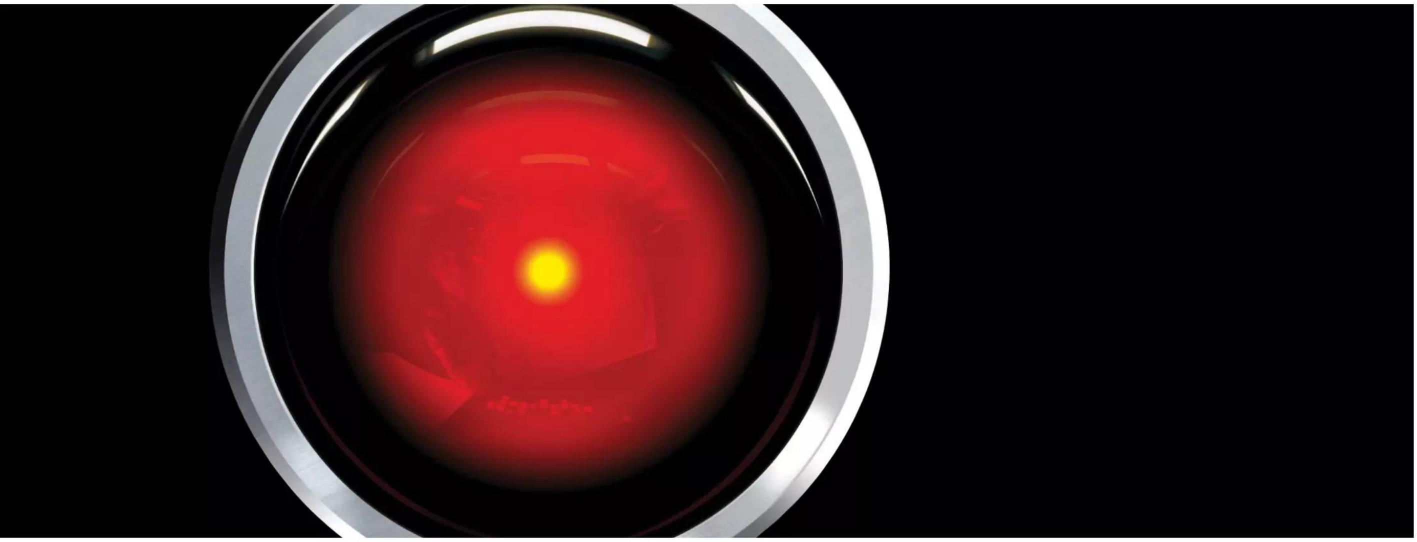
So you've got the hardware, you know the gist, what AI tools are out there, and how can you spice up your life, improve productivity, and boost your own creativity (without compromising on creative integrity). Now, we present to you 20 of the best tools out there for you to try out today.

CONTROVERSIAL CREATION

The initial launch of AI has come under significant fire from the creatives in the industry, whether that's artists, script-writers, journalists, authors, movie directors, animators, or musicians. Many have had work taken without consent or payment, and used to feed these data-hungry models' progress, which then typically spit out similar content that although technically isn't stolen, may as well be.

Similarly at *Maximum PC*, we wholeheartedly stand against plagiarism, content theft, and efforts similar to this. After all, AI as a whole should be seen as a symbiotic relationship, not a parasitic one. It should complement, not detract from human creativity. Use it for inspiration or problem solving to improve your own work and efforts, rather than copyright theft or impersonation.

This will ultimately always come down to the individual, but similarly, AI right now is very much still developing, and as such, the content produced is similarly flawed. Whenever you work with AI,

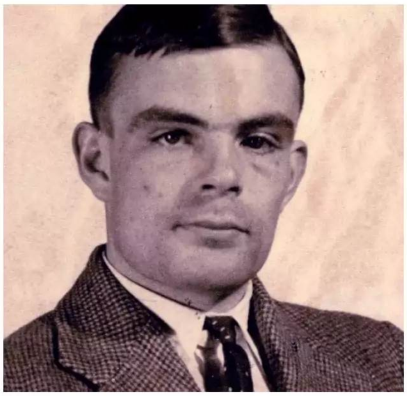


there might be moving forward, and a list of some of the best symbiotic AI tools that you can use to enhance your productivity, creativity, and general day-to-day workflow.

A QUESTION OF PHILOSOPHY

For anyone who is not well versed in antiquity, you might be surprised to know that AI as a term is pretty ancient by design. Humans have been dreading the rise of AI since well before 0 BC. In fact, Talos, in ancient Cretan mythology, was a metal giant imbued with intelligence of its own, capable of defending the Mediterranean isle.

Since then, it has sprung up in all manner of eras and nations, from China to the UK and beyond. It gained precedence once again in the Renaissance era, as philosophers dissected and debated human consciousness as having a mechanical nature to it. René Descartes, in particular, similarly envisioned it being possible to be able to mimic that consciousness in an artificial construct if you could understand the mathematics behind it.



Alan Turing, once again at the forefront of all things computing.

© WIKIPEDIA

Finally, in 1913, the mathematical theory arrived that would begin to bring AI to the fore once again by formalizing the mathematical reasoning behind it, this time courtesy of Bertrand Russell and Alfred North Whitehead (both of whom are accredited as being mathematicians and philosophers, among many other accolades). This was then built up over the years, until finally, with the advent of computing, and the understanding that AI itself could fully exist inside a machine, (with, at the time our understanding of neurons effectively acting as absolute on-off switches), a man by the name of Alan Turing began work researching machine intelligence as well.

From there, research and development continued for a number of years, with hypothetical promises laid out as to how AI would work, and how beneficial it could be to humanity, or financially profitable to the company that cracked the code.

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in any capacity, it's advisable to pay close attention to the small details. If you're working with LLMs, don't take everything as gospel; back up your queries with additional research.

In fact, there are a number of AI tools designed to pick out work created by AI. Likewise, they're still very much in their infancy as well, and have flagged genuine authentic copy as AI generated, but like most things, it's up to you as an individual how you use these tools.

CHATBOTS

01 ChatGPT

https://chatgpt.com

The one that started it all. Developed by Open AI, ChatGPT has gone through numerous iterations since its initial inception. There are two current versions: a free variant, giving you access to GPT 3.5 and limited access to GPT-4o, and a paid version ($20 per month) that gets you the latest GPT-4, which features better safeguarding, more free-flowing answers, and image input.

02 Google Gemini

https://gemini.google.com

Recently updated from Google Bard, and similar in many ways to ChatGPT, Gemini excels predominantly in handling prompts based around text, code, images, and sound files. It's also far quicker in its free variant than its ChatGPT counterpart. The advanced version, similar to ChatGPT, gives you access to better analysis, along with integration into Gmail, Drive, and Google Meet.

03 Microsoft Copilot

https://copilot.microsoft.com

Although hot on the heels of Google Gemini and ChatGPT, Microsoft's own Copilot isn't lagging behind by any great length either. With beta access

Over the years, we've had a number of setbacks—or AI winters, as some academics call them—until finally in 2022, ChatGPT debuted, once again turning the attention of the populous back toward artificial intelligence.

GAME AI

While the idea of an absolute man-made consciousness residing in a machine may be terrifying or exciting to us today, the reality is that we have been living with a kind of AI for an incredibly long time. Games themselves typically use a form of AI to provide that PvE (player versus environment) experience that we've all come to know and love.

In fact, this first arrived in 1951 when Christopher Strachey of the University of Manchester first wrote a program that would mimic a game of checkers, with the user playing against the AI.

Game AI, although perhaps quite different to our general idea of AI by modern standards, still very much behaves in the same manner as LLMs and ANI (artificial narrow intelligences), but it has far less data available for it. Modern-day game AIs, at a very basic understanding, run off three key ingredients: you have your environment, conditions, and triggers.

A game AI will be hard-coded to only function in a certain manner based on a particular set of parameters. These usually extend to its own conditions, the environment in which it and the player inhabits, and any triggers that have been activated. The environment, of course, would be the game world, and the AI's arena. This includes out-of-bound boxes, aggro ranges, and more advanced features. Then there's conditions, which would be total stat values, health, attack ratings, and so forth. Finally, you have triggers, which could be if the AI's health hits a certain percentage, then do X, or if the player crosses a mark on the ground, then do Y, or if a certain amount of time has passed, then do Z.

In this manner, although an AI may seem aggressive in-game, or proactive, the reality is that it's actually still behaving in a reactive manner. You can think of it, very simply, as an 'if this, then that' model—not necessarily what we would imagine an AI to be.

Artificial intelligence in modern videogames operate in a very similar manner to what we consider modern ANIs.

© WIKIPEDIA, XBOX GAME STUDIOS / AGE OF EMPIRES 2: DEFINITIVE EDITION

Chat GPT, the first to break new ground, is an ANI, or generative AI.

ANI VS AGI VS ASI

In theory, all modern AIs currently land somewhere on the generative scale (we technically class them as ANIs). What that means is that these AIs use deep learning, algorithms, and a copious amount of data to structure responses, or create something based on the prompts that the user inputs to them if they correlate with the data that the AI has at its disposal.

It does this by identifying patterns and trends. For instance, if you ask an image generation tool such as Microsoft's Creator to draw you an image of a Super Saiyan from *Dragon Ball Z*, it will look at its database of images on Super Saiyans, examine the word prompts you've given it, the tags on those images, and what you're drawing, then try to fill in the blanks to meet that target.

You might have seen this term in more modern versions of Adobe Photoshop as well, where a similar feature known as 'generative fill' exists. In the same manner, it'll look at the subject matter that you've provided, match it in its pattern recognition, then generate new content to fill in the gaps or blanks based on the

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now available on Windows 11, it's being incorporated into a number of upcoming and newly released laptops. Think of it as a more advanced Google search, but available at the press of a button—maybe Microsoft's biggest failing with Edge, Explorer, and even Bing.

IMAGE AND MUSIC GENERATION

04 Midjourney
www.midjourney.com/home

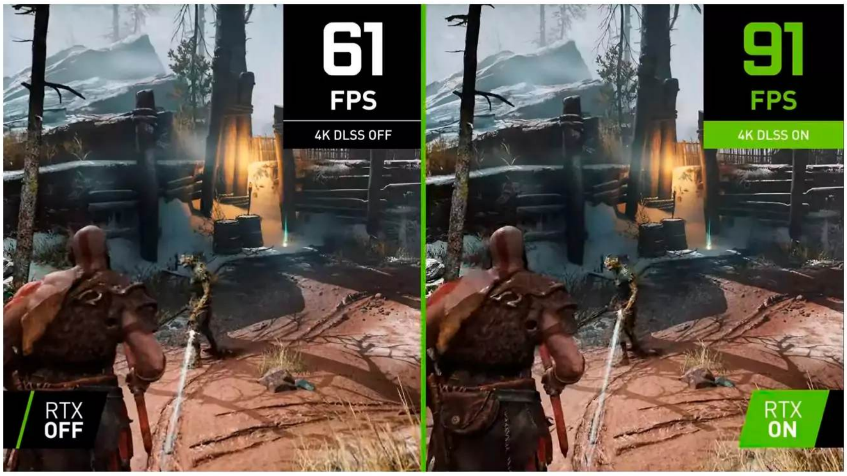
Baked directly into Discord, the Midjourney bot allows you to create imagery on the fly from a few simple prompts. Join the Midjourney discord, sign up to a subscription, then find the correct channel, type / imagine, plus your prompt, and Midjourney will begin to generate the image, utilizing its own cloud-based GPUs. Each subscription has limited available GPU time, so do bear that in mind as you request images.

05 Stable Diffusion
https://stability.ai

Stable diffusion is similar in many ways to Midjourney, being able to create imagery off the back of only a few text prompts. Interestingly, however, it's also turning into a bit of a technology suite, with a variety of features, video creation, audio editing, background removal, generative fill, music generation, and even more advanced features on top of that. Similarly to Midjourney, it does require a subscription, with the monthly sub starting at $9, and going all the way up to 11 times that.

06 DALL.E 3
https://openai.com/index/dall-e-3

Now predominantly found inside ChatGPT, and developed by the team over at OpenAI, DALL.E 3 looks to improve on its predecessor by providing protection for living artists



Super sampling uses machine learning to improve frame-rates by effectively predicting what the frame should look like through pattern recognition.

images it has available that match that pattern. If you've taken a picture of puffins in Iceland, for example, it'll likely be able to spot similar images in its database, identify scenery, landscapes, and features that look similar, identify the patterns and how that landscape is formed in those images, then expand that in your image.

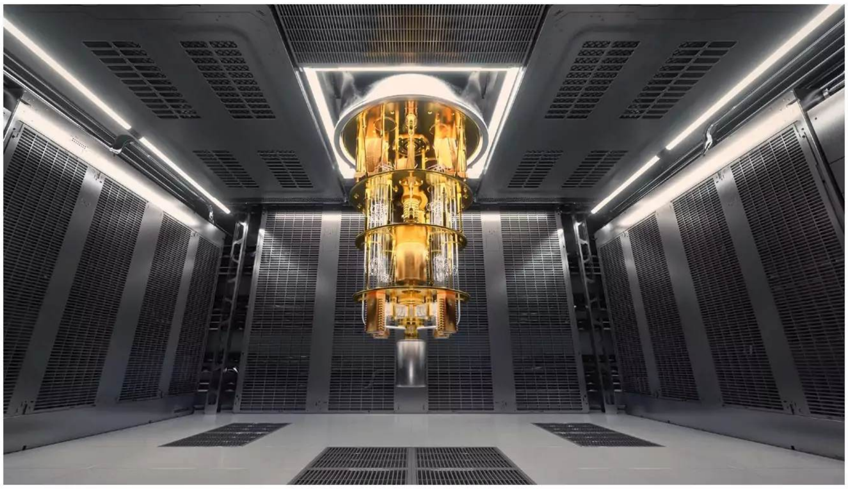
This is effectively a form of deep-learning analysis. Over the last few years, the computing industry has made tremendous strides in this field, as it's also the same base principles that are behind techniques such as Nvidia's DLSS, AMD's FSR, and Intel's XeSS upscaling/super-sampling. It's also used in all manner of scientific and large data-set fields, too.

It's particularly useful for languages and written text. LLMs (Large Language Models), such as ChatGPT, Google Gemini, and others, are based on this principle. If an AI has enough access to the raw copy and material, it can find patterns and correlate that into the correct sentences and structure. Interestingly, this is how the majority of humans learn their first language as children, and how many languages were first deciphered: by studying patterns. Likewise, you'll likely have seen a number of 'character' AIs pop-up, where they imitate certain book or movie characters. This is again all thanks to having access to the media with that character in, understanding that context, and applying it to a new set of prompts.

AGI - ARTIFICIAL GENERAL INTELLIGENCE

To be clear, however, although these ANIs can produce human-like responses, and even pass the Turing Test in some cases, they are still effectively reacting to a trigger based on a set of conditions.

The next step, and arguably one that needs considerable ethical and moral consideration, is the move into AGIs (Artificial General Intelligence). In this scenario, not only would the AI be capable of that deep-learning, with overwhelming instant access to a huge amount of data, it would also be able to self-correct, ask



Quantum computing may well be the only way a true AGI can form.

© NVIDIA, JOHN D/ISTOCK / GETTY IMAGES PLUS

as well. However, similar to the above, you'll need a subscription to access it, as it's currently only found in the 'Plus' subscription in ChatGPT directly. Technically, ChatGPT can draw you incredibly rudimentary designs by itself, but be prepared for the worst.

07 Mubert AI

https://mubert.com

Built specifically for music generation, Mubert allows you to create tracks from all manner of prompts and inputs. You can create tracks, jingles, loops, and everything in between with text input, imagery, or even just pick a genre, instrument or even just a BPM, and get it to make one up on the spot. The free versions are, of course, watermarked, with commercial use subs starting at $39 per month. Results are mixed.

08 Fliki AI

https://fliki.ai/features/translator

Although Fliki does allow you to generate AI video content on the fly with just a few word prompts, its biggest advantage is the editing tools that are available, particularly the ability to translate and dub one video into another language. Its editing suite is super-easy to navigate, and allows you to upload your own content and translate it into over 75 languages. Like those before, again this requires a $21-per-month subscription to activate.

09 Unscreen

www.unscreen.com

Another favorite of ours is Unscreen. Although far simpler than a number of options on this list, it allows you to fully remove the background in any video and keep just the subject matter. It works surprisingly well,

FEAR THE ANI

Although AGI and true artificial consciousness is still a long way off, the threat AI could present is still no less tangible with generative ANIs. Disinformation in the digital age has become incredibly common in recent years, with bad actors taking advantage of ANIs and other such tools to besmirch, incite, or encourage outcomings that they find beneficial.

Deep fakes have affected all manner of people, with politicians, sports club managers, celebrities, and even our own friends and family being spoofed and targeted with the technology. There have sadly been a number of reports of robo-callers imitating loved ones' voices, asking for money, simply through finding that person's voice online and then mimicking it by utilizing AI over the phone to family and friends. On top of that, generative ANI has the capacity to quickly break through even some of the toughest encryptions out there, making them incredibly powerful password crackers as well.

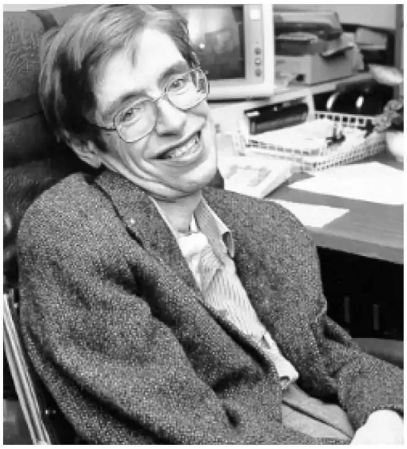
Although modern media typically portrays AGIs as being a doomsday-esque event for humanity, ANI is potentially the far worse of the two, certainly today. There is no consciousness to question a decision—an ANI will act on the prompt it's given, and within any parameters set, and similar to our Game AI we described earlier, is only constrained by the environment and laws placed on it by its creators. If bad actors create ANIs or use them for malicious purposes, then there's little that can be done to stop them other than using your own AI to protect against those attacks.

In June 2023, for instance, Reuters reported on a story about a USAF official suggesting that during an AI simulation, a drone killed its operator to allow it to complete the mission it was assigned, as the operator kept getting in the way of its objective by forcing it not to kill the target. This was later denied as an external thought experiment, and that the USAF obviously wouldn't need to run that scenario to identify the risk, as it's clear from the outset. Nonetheless, there are challenges that this type of programming represents, particularly when it comes to armed warfare.

questions, feel emotions, respond without prompts, and create its own content. It's effectively a human consciousness in all but name. Think JARVIS in *Iron Man*.

This is an area that's still seeing considerable investment and continual improvements, but there are substantial technological hurdles that need to be overcome before an AGI can be brought to life. In fact, this has been a pipe dream of many technologists that have seen it stagnate across a number of AI winters over the years.

An AGI requires far more processing power than generative AIs, and a fundamental change in how those computations are calculated, if they are calculated at all. Most, if not all, modern ANIs run on traditional silicon transistors due to their IFTTT nature, where you get either a 1 or a 0 state. AGIs will require quantum computing to facilitate that true effective 'consciousness' with states in between 1 and 0.



Stephen Hawking was one of many notable scientific figures to have expressed concern about the runaway effect an AGI could facilitate.

© NASA/WIKIPEDIA

That in and of itself provides serious problems, as quantum computing is still a developing field, and although the computing prowess and puzzle solving capacity is vast in comparison to traditional 0s and 1s, and development equally rapid, quantum computers are certainly nowhere near as dominant as the traditional computer currently is.

Additionally, quantum computers are inherently volatile by their nature, requiring significant environmental shielding to prevent qubits interacting with various forms of radiation potentially corrupting their data state. That alone will inevitably mean that for a true AGI consciousness to form, it would need to be buried likely deep in the earth, only

even with hair, and otherwise difficult clothing, too. It's great for creating camera overlays for gameplay clips and other YouTube content.

PRODUCTIVITY

⑩ QuillBot (Writing)
https://quillbot.com

If you've ever used something like Grammarly, or even modern Google spell check, then QuillBot is going to be very familiar to you. It's specifically designed to improve your writing, fix grammar, and more. One of the more intriguing elements, however, is its synonym slider, plagiarism checker, and even AI detection tools, some of which are actually included in the free version. Better yet, it's available as a Chrome extension right out the gate. Bear in mind that it's not flawless, however. If you have a particular style to your writing that goes against the norm, yet is still grammatically acceptable, then QuillBot may identify it as 'incorrect'.

⑪ Fireflies AI (Transcription)
https://fireflies.ai

If you've ever been in a call or interview, and had to transcribe the resulting recording, you will know the pain it brings. There are a number of paid services out there that can provide you with transcription services, but Fireflies AI is our favorite. Similar to the above, there's a Chrome extension for it as well. It'll listen in to your meetings, and happily take notes, transcribe entire scripts, and even list action items for you. On top of that, it's compatible with Google Meet, Teams, and Zoom. It can even place timestamps and smart search through your recordings.

⑫ ZeroGPT (Plagiarism)
www.zerogpt.com

ANI's without proper programming will actively do anything possible to achieve their objectives.

© LT. COL. LESLIE PRATT/WIKIPEDIA

accessible via networking or direct forms of communication.

ASI - ARTIFICIAL SUPER INTELLIGENCE

There's also the fear that if an AGI was created, it would lead to a runaway effect with the technology rapidly improving itself continually. Stephen Hawking, in a 2014 interview with the BBC, famously stated that the development of it could end the human race entirely. It would reach a point where its intellect and computational capacity would far outstrip that of any human. This is referred to as a technological singularity, reportedly stated by John von Neumann prior to his death.

A Super Intelligence in and of itself is hard to define, as there's no true criteria for it, other than its own individual intellect surpassing humanity's collective intelligence. Theoretically, it would be capable of solving any problem, and continue to rapidly improve itself, and grow faster as it did so. The argument, of course, is that at that point, given it should be emotional, with a consciousness of its own, how exactly would it view us as its lessers, and more importantly, how would it treat us in response?

There is some argument as to how accurate this portrayal actually is, however, as almost all human technology to date has reached a point of diminishing returns at some point in its development, either through power or efficiency, where each new generation typically leads to less and less gains as a result; limits often defined by physics itself. Even our silicon transistors continually shrunk, and first defined as increasing in density and performance by Moore's Law will reach a point where quantum tunneling is impossible to avoid, at which point alternative technologies will be needed to circumvent that problem.

HARDWARE REQUIREMENTS

So then, unlikely doom-mongering aside, what do you actually need to run today's generative AIs? Well, a lot of it is going to come down to what kind of AI tasks you intend to run, and whether or not you have access to the cloud.

There are some generative AI tech elements that are slowly filtering to a personal user level. Microsoft is banking heavily on this with a number of its search elements, along with Copilot having access to your files. This requires specialized hardware to improve the processing speeds of these functions.

Another fantastic tool that's particularly useful for those in teaching, or for checking on whether content is AI generated or not, is ZeroGPT. This looks for common AI patterns in writing, identifies them within the copy, then gives you a score as to how likely it is that the text input is written by GPT. Forewarning: it's not flawless, as parts of this feature's very intro were flagged as potentially being AI generated. We're not sure whether to take that as a compliment or not.

⑬ **Superhuman AI** (Emails)
https://superhuman.com
Superhuman is everything a good generative AI should be. It helps save a ton of hours on emails, with a bevy of features, including writing out emails that sound like you from just a few sentence prompts. It can also automatically split off important and VIP emails that you miss, and even send chaser emails on your behalf. It's not cheap, however, starting at $30 per user per month, and there's no free trial currently available. It's also a bit of a pain to unsubscribe from—definitely a larger business play, rather than an individual pick.

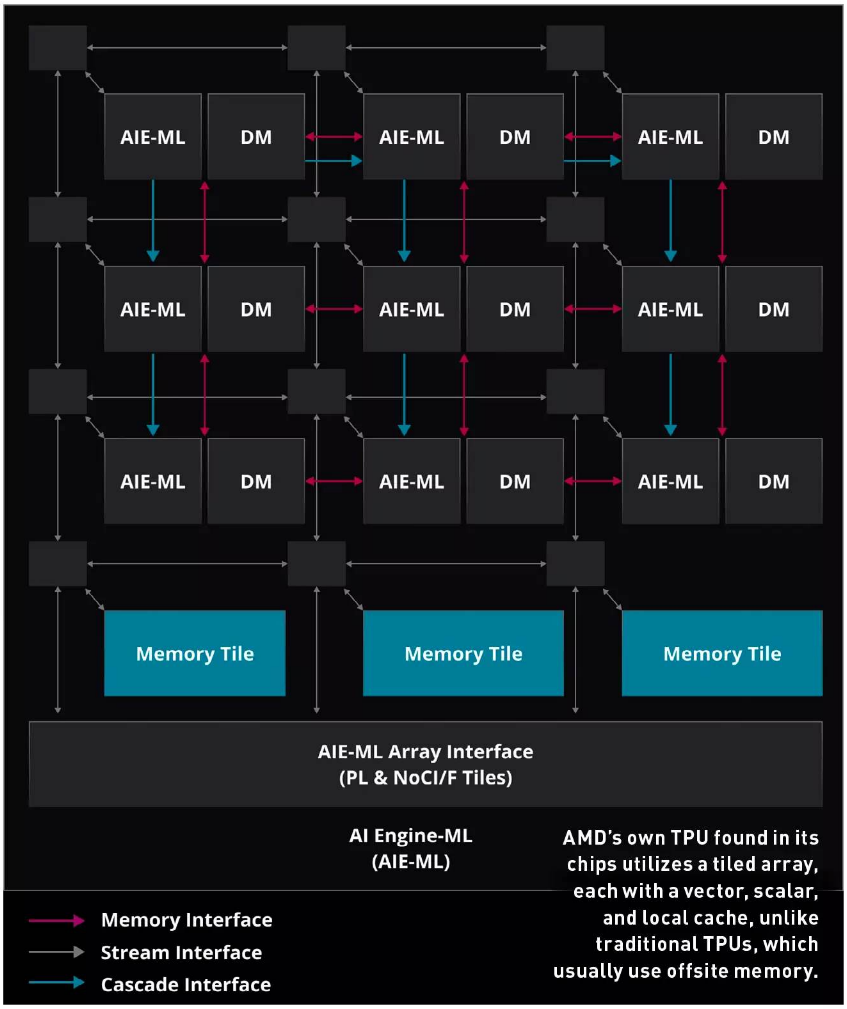
⑭ **Just Ask Layla** (Travel)
https://justasklayla.com
Just Ask Layla is a powerful travel planning tool if you're not quite sure where you want to go or what to do. It's backed by a pretty potent LLM, and can give you a ton of information on your travel plans and adventures. It can even book flights for you, recommend hotels, restaurants, coffee shops, and things to do. As a challenge, we asked it to plan an itinerary for a trip to Nepal around the Annapurna trail range. It knew that you need 15-20 days to complete it, which time of year

This is typically found in your CPU directly, and is known as an NPU (Neural Processing Unit). It's effectively a smaller co-processor or accelerator, so to speak, tasked with handling specific workloads that a traditional CPU would find too energy inefficient to do. As an example, it's very similar, in a way, to video decoders, or dedicated ray tracing hardware.

That said, they're not currently available in all desktop processors—only a select number. AMD's Phoenix generation of chips (8000G desktop series and its 7000 laptop series have them), Intel's Core Ultra laptop series, and of course Snapdragon's, plus Apple's ARM-based processors also feature NPUs.

NPUs are designed to be able to perform better in parallel processing applications. Machine learning and AI tasks in general, such as inference, and pattern recognition and training, typically rely on this types of processing to perform those particular tasks. They also help with fields such as image processing, video filters, voice recognition (like Amazon Echo, Google Home, or Apple's Siri), AR, image artifact removal, skin smoothing, and other gray-area applications.

Talking very specifically from a generative AI offline perspective, as you're only looking at your own personal files, the processing power required to compute that and identify those patterns is minimal. Of course, it will depend on the user in question and how many files they have locally on their system, but for the technology itself to function, AI requires little in terms of hard processing power from the NPU directly. This is why you'll find a number of smartphones, and even watches that are capable of fairly standard typical AI workloads these days.



AMD's own TPU found in its chips utilizes a tiled array, each with a vector, scalar, and local cache, unlike traditional TPUs, which usually use offsite memory.

©AMD

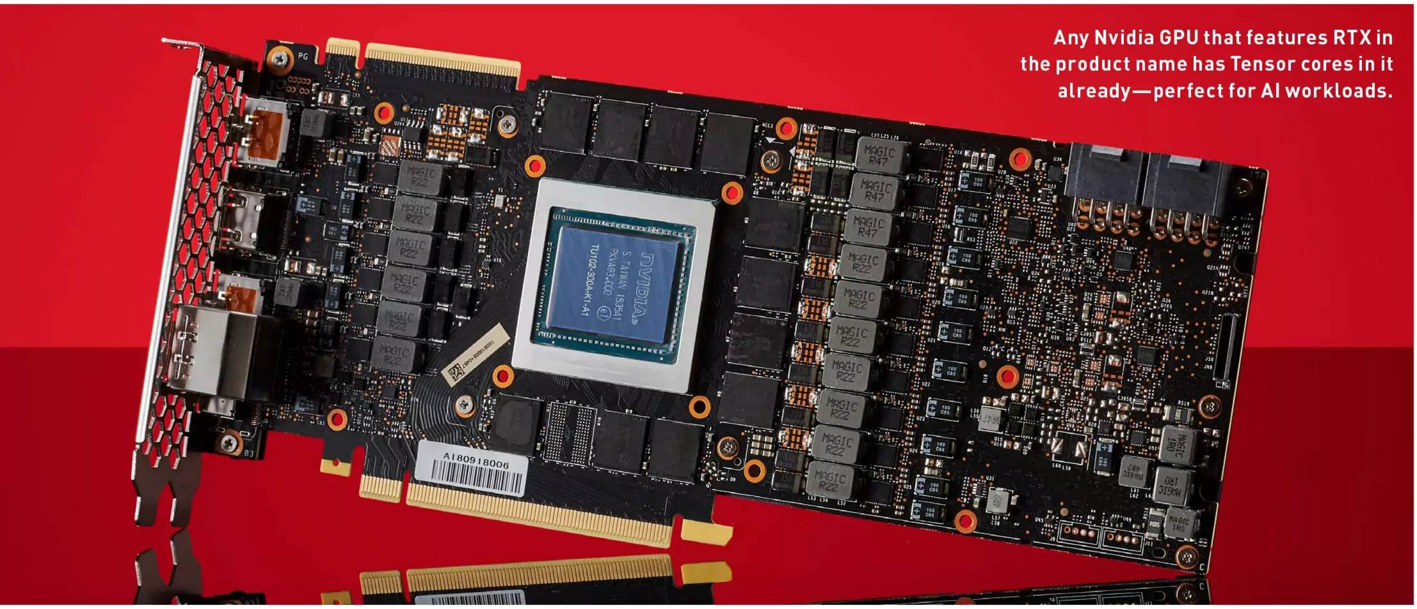
The only metric you need to worry about when it comes to NPU performance is the TOPS (tera operations per seconds). This denotes just how many operations the NPU can output per second at a factor of 2 to the power 40. The higher the number, the better the performance. With mobile computing, power efficiency here is key, so you'll also likely see TOPS per Watt as well, denoting improvements here.

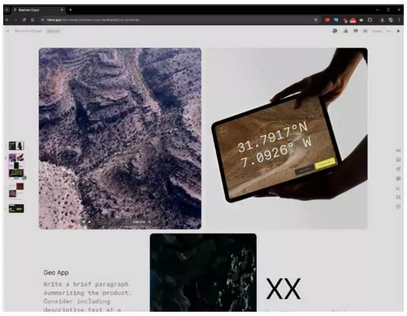
to go and do the expedition, and then planned a full 20-day itinerary for it. It's free to a point, then $5 a month.

⑮ **Tome AI** (Presentations & Planning)
https://tome.app
Tome is all about business, and looks to take the fight to ChatGPT and others, but with more of a professional, sales-orientated spin on it. We picked this predominantly because it's helpful when it comes to building advanced presentations. It's super-quick to build decks, streamline data, and has a whole host of analytics baked into each deck. You can generate media, layouts, have interactive embeds, or pull entire Google docs into it, and have them converted into a presentation that's multi-format, readable, and attractive. The pro version starts at $16 a month.

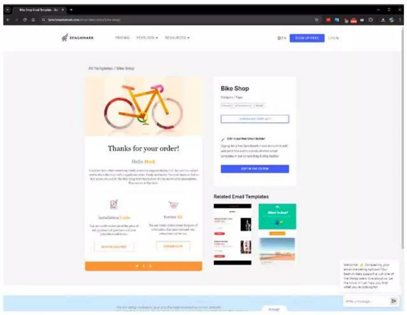
⑯ **Scholarcy** (Summary)
https://library.scholarcy.com
Scholarcy is very good at summarizing large papers and providing short summaries of large bodies of work. Simply input a document, web URL, or otherwise, and it will provide a summary of that body of work, along with highlights, a synopsis, the key concepts, and more. Of course, there's a subscription model, with limited uses per week without it, but it's reasonably priced, and ideal if you're trying to brush up quickly. It'll even produce flashcards on any topic you've input.

⑰ **DeepL AI** (Translation)
www.deepl.com/en/translator
DeepL is a phenomenal translation tool that far exceeds the limitations of Google's native translator. Not only can you translate entire documents, you can pick out synonyms, choose the translation tone (ie. formal or informal), create glossaries ensuring your key words are always accurately translated, and more. Pricing plans are available, while the free


Any Nvidia GPU that features RTX in the product name has Tensor cores in it already—perfect for AI workloads.



Tome is all about business, and looks to take the fight to ChatGPT and others.



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DO I NEED TO GET AI READY?

No. Right now, NPUs are typically only found in mobile, laptop, or similarly designed chips. Even AMD's latest Ryzen 9000 series processors don't feature an NPU at the moment. This may change in the future, as ANI becomes more tantamount, and Windows and similar operating systems incorporate ANI features into their very makeup, but it will still likely be one to two generations before we see dedicated NPUs land on high-end desktop processors or similar.

In theory, a lot of this workload is already handled directly by your graphics card on these higher-end systems. Any RTX graphics card from the 2,000 series onward has its own dedicated 'Tensor' cores on board (not to be confused with Google's TPUs (Tensor Processing Units), which act in a very similar manner to a dedicated CPU's NPU. In fact, certainly in regard to general ANI workloads, they're far more advanced than your typical NPU.

In essence, the processing power to drive machine learning and deep learning super sampling is far greater than that of the traditional generative AI we use today. ⏻

version is limited to three non-editable translations with limited character counts, and your glossary can only house up to 10 unique entries.

⑱ Make (Workflow)
www.make.com/en/product
Tinkering with workflows is a time-consuming enterprise. If you've ever done any form of data analysis, you'll know the frustration that comes from developing a solid workflow. Make allows you to visually build workflows, then implement them rapidly, from data collection and processing, to order fulfillment, contract management, inventory management, and a whole host of other processes. There's a free version, but pricing generally starts at around $9 per month.

⑲ Benchmark Email (Emails)
www.benchmarkemail.com
Benchmark Email is all about mailing lists, email campaigns, and creating some phenomenally clean-looking email designs on the fly with the help of AI. You can use it to build out publication newsletters, order notices, and a whole ton more, then automate the process of sending those emails out, before following up later down the line—all based on triggers. AI features are still held behind a monthly subscription, as to be expected, with pricing starting at $15 per month.

⑳ Character AI
(Entertainment)
https://character.ai
Without a doubt, a more fun pick than some of the others on this list. You can find all manner of book, movie, TV, and even celebrities listed here, and ask them anything based on anything imaginable, upon which they'll respond in kind. Many of these have simulated voice acting over the top. It can be quite the experience, and addictive. Perfect for building stories.

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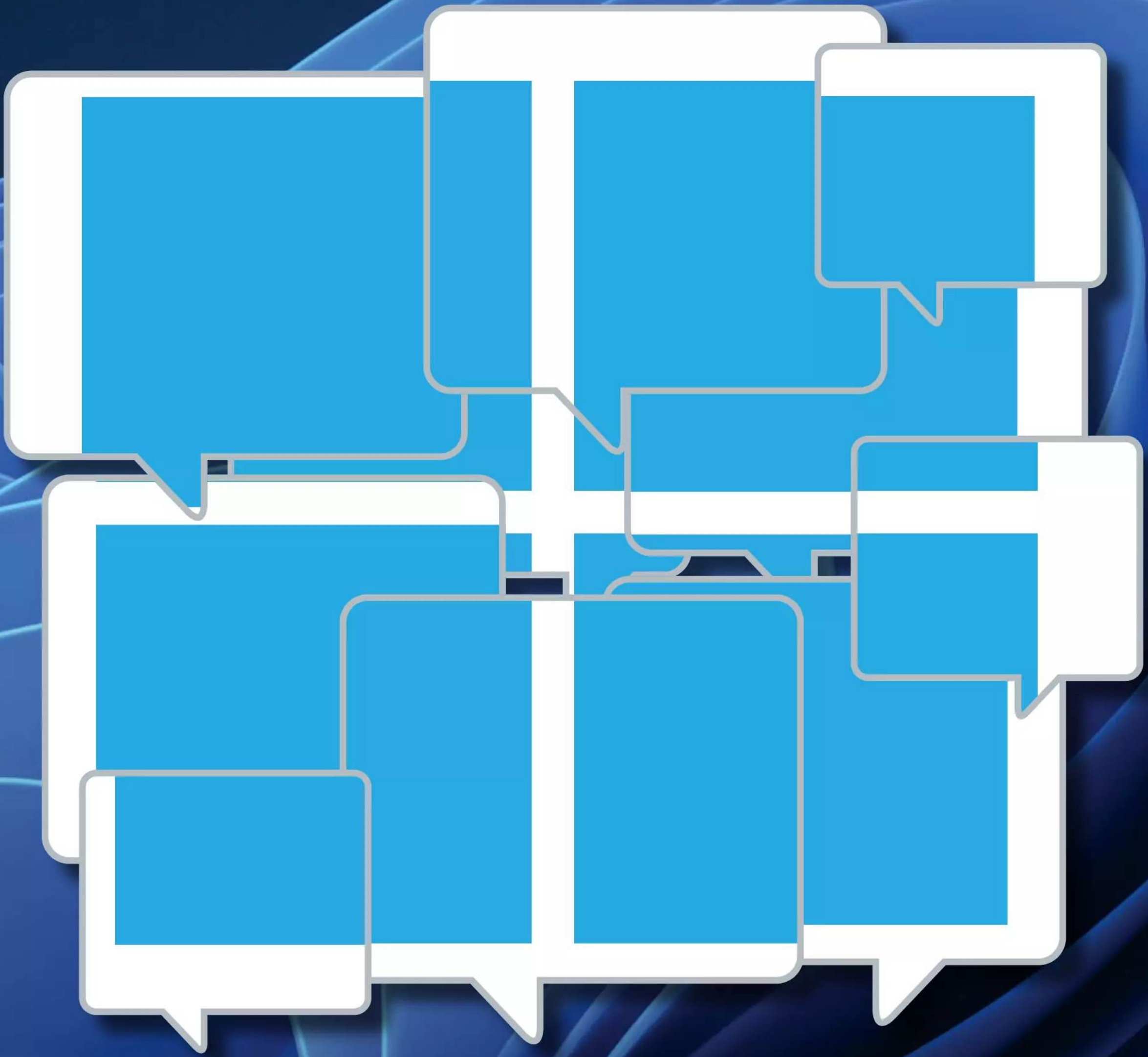
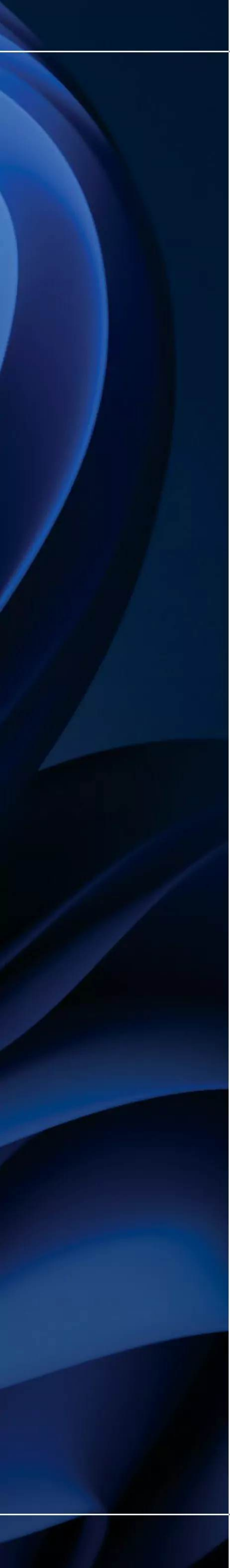


WINDOWS 12 WHAT WE WANT

With the next version of Windows likely to land this fall, we present our wishlist of new features—and what old features we want to see the back of



WE LIVE IN HOPE. Hope that Microsoft commits to a full new operating system this fall, rather than yet another feature update, as some predict. But most of all, we hope that Microsoft creates an operating system that solves our frustrations, stops hitting us with ads, and opens up new possibilities.

To come up with our list of most wanted features in Windows 12, we went to the experts—writers and contributors who use Microsoft's Operating Systems on a daily basis. We've grouped their requests under common themes for easy navigation (coincidentally, a much-requested Windows 12 feature), with full names listed at the end of the article.

We also spoke to users, including Lee Grant (see boxout 'Features: What Needs to Change?') who runs a PC repair shop and interfaces regularly with frustrated users who need help with common Windows problems.

Will Microsoft deliver? We continue to live in hope.

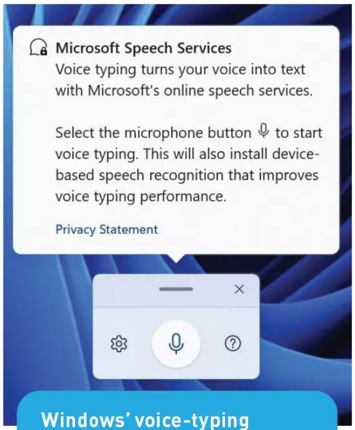
Usability & interface

PROMOTE WINDOWS GESTURES

I used to cry myself to sleep at night because I thought Microsoft had removed the 'shake to minimize' gesture, where you grab a title window, shake it, and all the other apps minimize to the desktop. What I didn't realize is that it had merely hidden the option away: search for 'Multi-tasking settings', and you'll see it there, bold as brass. That's my problem with Windows gestures: they're genuine time-savers, but Microsoft has done such an awful job of promoting them that all the onus is on us, the users, to seek them out. Whether people are using mice or touchpads, Microsoft needs to push gestures to the fore in Windows 12. *TD*

MAC LEVELS OF COHESION

A common phrase you'll hear about Apple products is that "they just work", although the company obviously has the advantage of controlling both hardware and software. Microsoft has attempted to create a more cohesive experience for customers across Android, iOS, and Windows through apps on phones and tablets and its own Phone Link system built into Windows 11. The trouble is, both are afterthoughts. With Windows 12, it has the opportunity to steal ideas from—sorry, be inspired by—Honor and Samsung that detect if a tablet or phone is nearby, and then work out ways to swap files between them, or turn them into secondary screens. *TD*



Microsoft Speech Services

Voice typing turns your voice into text with Microsoft's online speech services.

Select the microphone button 🎙 to start voice typing. This will also install device-based speech recognition that improves voice typing performance.

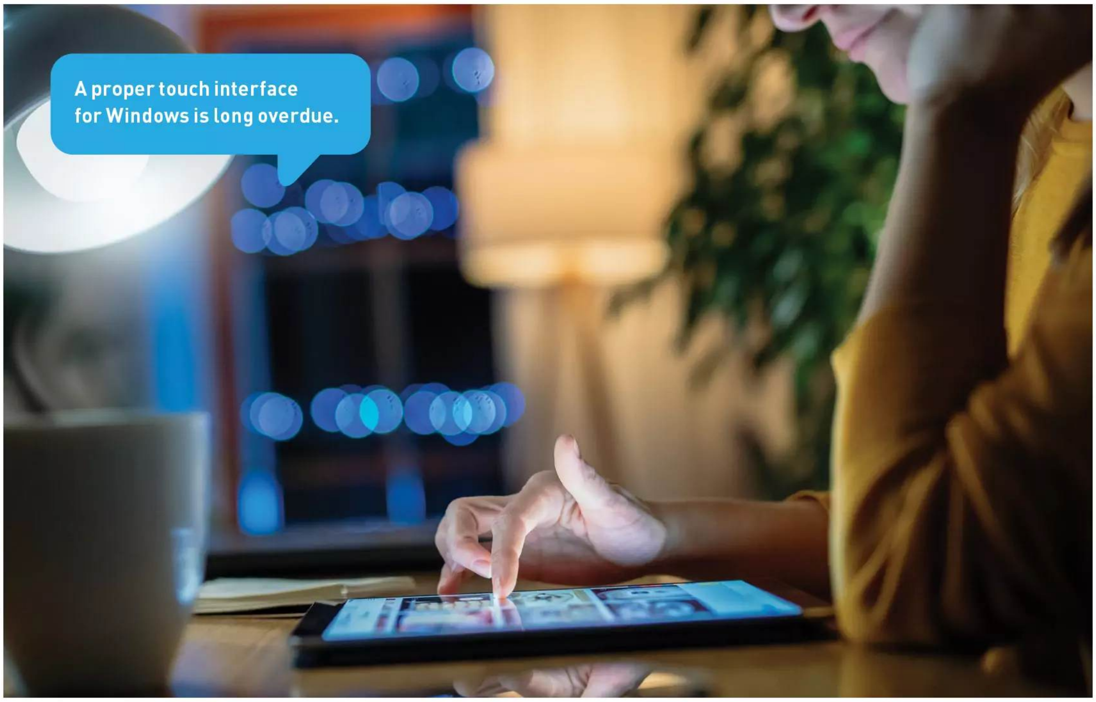
Privacy Statement

Windows' voice-typing capabilities should not require calling on the cloud.

A PROPER TOUCH INTERFACE

The Windows 11 desktop isn't a touch interface. Trying to donk tiny icons on a seven-inch screen is like trying to thread a needle with a climbing rope. Consequently, manufacturers resort to their own overlays in an attempt to try to make the OS usable.

I know we've been here before with Windows 8, but Windows really does need both touch and non-touch interfaces, with touch scaling as required to the size of the device. It shouldn't be beyond the wits of Microsoft to pull this off. *BC*



A proper touch interface for Windows is long overdue.

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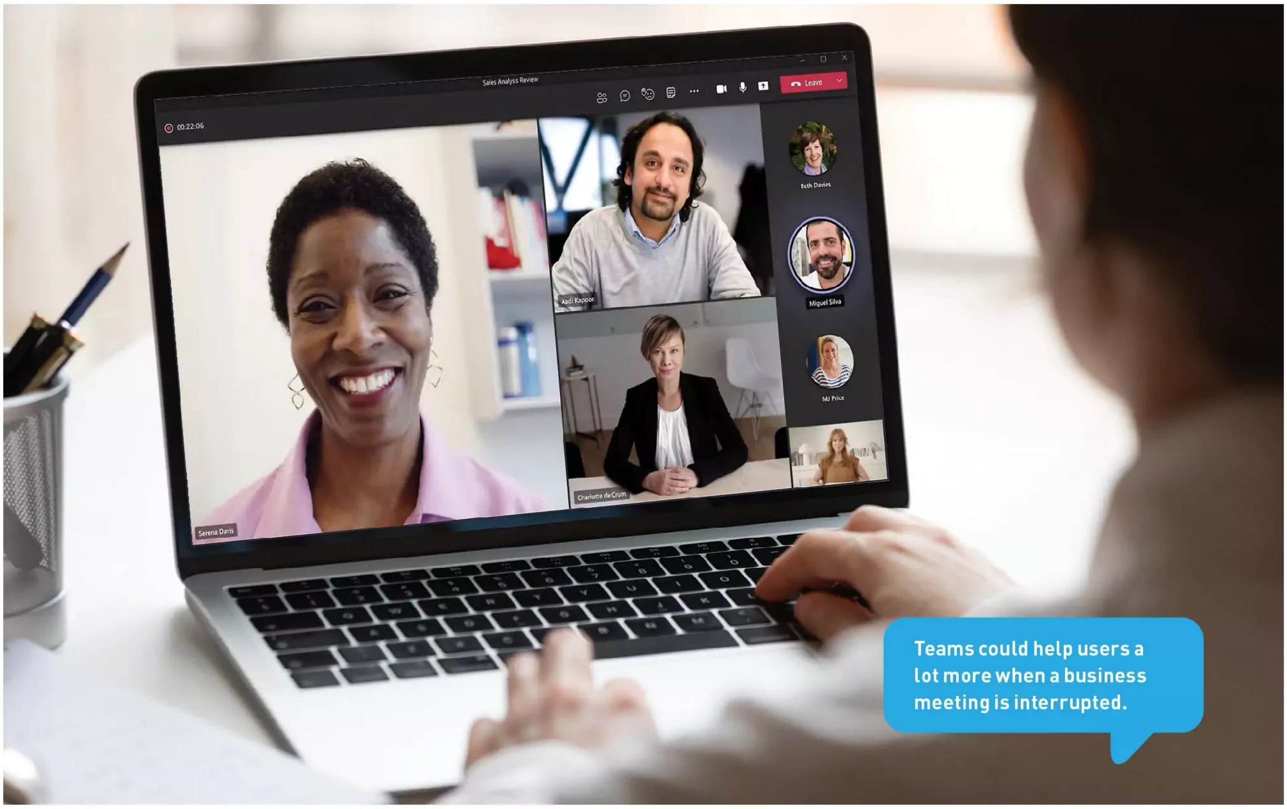


Teams could help users a lot more when a business meeting is interrupted.

BETTER SUPPORT FOR WINDOWS ITSELF

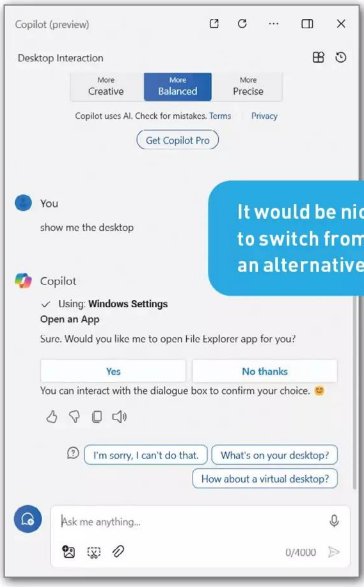
Isn't it a little strange that Microsoft has effectively outsourced support of its operating system to us? That is, the community of 'techies' that have to handle queries from friends and family in a Colombo-style 'one last thing' before we head out the door? Perhaps Copilot for Windows 12 will take some of the load, but judging from the absolute piffle that appears most times I've ever used Windows' built-in help, I somehow doubt it. *TD*

VOICE TYPING THAT DOESN'T RELY ON AZURE

We trust Microsoft with our data—that's not why we want to move voice typing from the cloud to our device. This is more about being able to dictate whenever and wherever we are, even if we're offline.

Products such as Dragon Dictate built names for themselves by handling offline dictation in the pre-cloud era, so it is possible. Granted, Dragon Dictate Professional also benefits from cloud processing and AI in its current form—and cloud processing, whoever the provider, should deliver accurate results that only ever improve as the back end encounters more diverse accents and a wider vocabulary when new users sign up.

It's also true that offline dictation products are set in stone when they ship, and while they're unlikely to evolve at the speed of a cloud-native rival, they can and do get more accurate if the user is prepared to correct errors when they crop up. Moreover, third-party offline dictation was already impressive ten years ago, and processors have become faster and much more capable in the interim. Why not use that potential? *NR*



Copilot uses AI. Check for mistakes.

You

show me the desktop

Copilot

✓ Using: **Windows Settings**

Open an App

Sure. Would you like me to open File Explorer app for you?

You can interact with the dialogue box to confirm your choice. 😊

I'm sorry, I can't do that.

What's on your desktop?

How about a virtual desktop?

It would be nice to be able to switch from Copilot to an alternative AI.

AI

CREATE AI SHORTCUTS

Last year, Microsoft announced the Copilot key, which is already starting to appear on new laptops (I expect to see it on keyboards later this year). This is all very well, but it ignores the hundreds of millions of Windows 11 computers that will never have such a key—and it's also rather basic. Instead, I'd like to see Microsoft take a leaf out of Logitech's book.

The company is using shortcut buttons so that its customers can better access AI features. Now, as a Logitech keyboard or mouse user, I can call up ChatGPT at a moment's notice or set a macro-style-stream of AI-based commands flowing. So come on Microsoft, why not do something similar? After all, you know exactly what keyboards and mice people are using. *TD*

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DESKTOP AI

It's a good bet that Windows 12 will be loaded with new AI features. My hope is that they're not limited to fripperies, such as automatically changing your desktop wallpaper or enhancing your photos in Paint. I want an AI that watches what I'm doing on screen and pops up contextual tools and controls to help me get where I'm going. Imagine a Start menu that could actually make helpful suggestions, based on what you're currently in the middle of—or an Explorer view that offered quick links to useful locations, based on the programs you've been using and the files you've been working with.

I don't think this is an unrealistic vision. Microsoft already ought to have petabytes of data about people's workflows—and if it doesn't, it has the infrastructure in place to very quickly collect it. The question is, does it really want to help users get things done, or is the fixation on AI actually all about marketing? *DGS*

FORENSIC-GRADE WEB HISTORY

It's about time we admitted that the History menu in most modern browsers should itself be consigned to history. It's time for a rewrite, with more intelligence—artificial intelligence, perhaps—in the categorization system. I want to see sites that don't redirect my browser too much, or have domain names that give no clue as to the country or company presenting them. What we need now from Windows are the tools to help us run our lives within our computers. *SC*

OPTION TO TURN OFF COPILOT (AND EDGE)

I'd like the ability to switch Copilot for an alternative AI. Microsoft invested heavily in OpenAI, so it's understandable that it wants to reap the rewards, and if that means smarter problem solving in Windows itself, great. But beyond that, how about allowing us to incorporate the LLM of our choice?

While I'm at it, I'd like Microsoft to stop thrusting Edge into my face. What happened to letting the user pick from a range on first boot? If that's going too far, then at least make it easier to opt for an alternative for every document type it can handle, rather than having us switch supplementary protocols and formats by hand.

Face it, Microsoft, your strategy isn't working. At the time of writing, Statcounter puts Edge's market share at five percent. Clearly I'm not the only one who turns on, logs in, and opts out. Making the Chromium engine part of Windows is fair enough, so apps can call on it when they need to embed web views. But Edge is a waste of space on most people's machines; an irritation that pops up when we least want it.

I'm not holding my breath. Browser dominance is a race worth winning and, with Microsoft adding dedicated Copilot keys to its keyboard design, I reckon native support for rival LLMs is even less likely than Edge being edged out. *NR*

Modern working

CREATE A HOME/WORK DIVIDE

With so many people now using the same hardware for both work and pleasure, surely it's time for Microsoft to create a split-personality option to match? Sure, we have 'Focus sessions', where you can set a timer and switch off, say, flashing taskbar apps, but I want a true distraction-free environment. It could be a virtual desktop that only displays productivity apps of my choosing, which I need to actively exit if I want to check Facebook. The only thing I ask: this should always be under user control, not some whip-wielding manager. *TD*

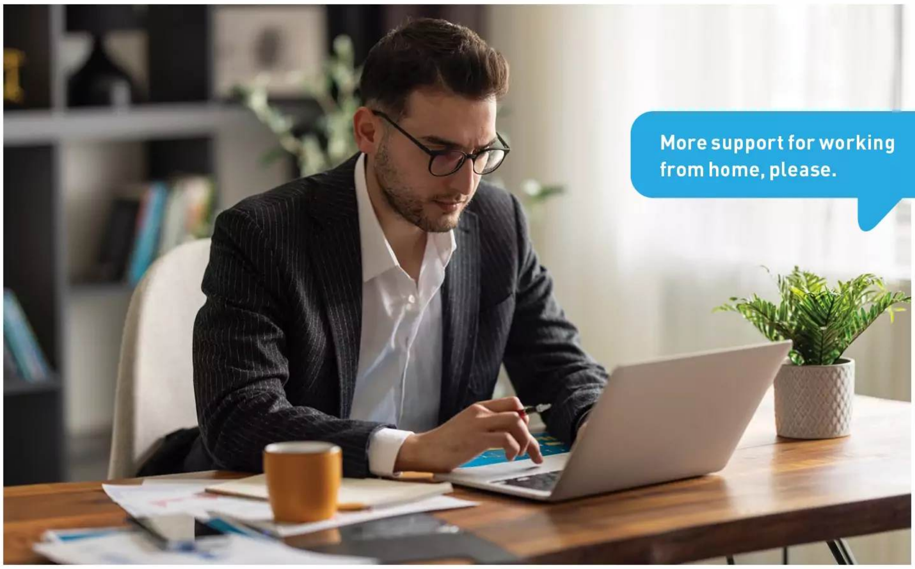
TEAM-WORTHY TEAMS

WFH is a big deal—not because it's innovative (Skype is 21 years old this year, by the way), but because it makes people nervous and obliges them to perform in front of colleagues. For some, this is like being invited to perform on *America's Got Talent*; for others, it's the most painful, drawn-out torture imaginable. So come on Microsoft, take some of the strain.

One example: stop making Teams so bloated that it drains all your computer's resources. Another: help your users when a business meeting is interrupted. Having to cope when Teams won't make a connection is, for some people, a major source of workspace stress. An AI that can present the same information as the old command-line utility PathPing in a reasonably simple interface—to show where your call data has been interrupted and by whom—would reduce blood pressure in uptight businesses all over the world. *SC*

BETTER WEBCAM SOFTWARE

We're finally reaching the point where webcams built into laptops produce half-decent results, so now is the time for Microsoft to provide software to match. I've come to genuinely appreciate the Studio Effects that add blur to backgrounds—so long as the processor includes an NPU to take advantage—but that's about the only change we've seen to this very basic app for years. *TD*



More support for working from home, please.

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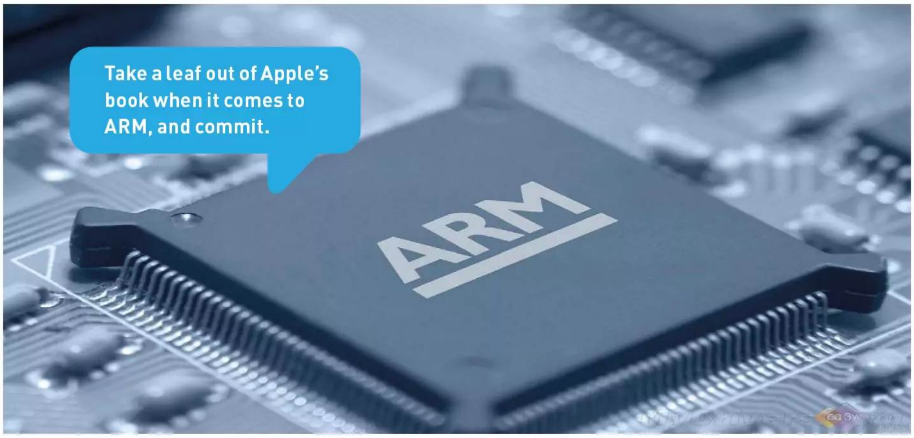
WEB CONFERENCE SKILLS

Together with better webcam software, I want to see clever Zoom/Teams/Webex integration. I have a plastic box that lets you run the conversation in the role of ringmaster, by way of half a dozen single-purpose plastic buttons and a Bluetooth radio. The fact that this reduces my stress levels shows just how unsupportive both Windows and the services are. I'd like Windows 12 to have a ringmaster smartphone app, with some tools for muting or handing over or setting some participants to voice-only mode, all aimed at making the 'call concierge' role less of a sweaty neck job. *SC*



Take a leaf out of Apple's book when it comes to ARM, and commit.

Architecture & performance

COMMIT TO ARM

We all know that Apple has the advantage over Microsoft due to its control over hardware and software, and nowhere has this been more obvious than through its switch to ARM. No kowtowing to partners—we've changed, get used to it. The results have been phenomenal in terms of both power and battery life.

In the meantime, Microsoft has experimented and fumbled with Windows RT, followed by Windows on ARM. Later, it announced that the first wave of its AI-enhanced Copilot+ PCs would launch exclusively on the ARM-based Qualcomm Snapdragon X Elite chip. The trouble is, Microsoft has history of deprecating its ARM-based operating systems, which doesn't exactly inspire confidence.

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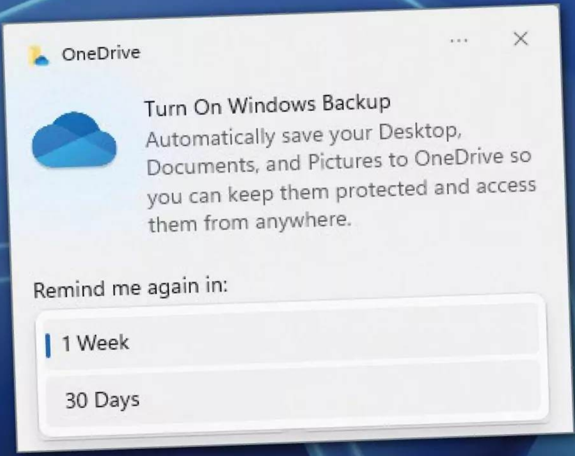
FEATURES: WHAT NEEDS TO CHANGE?

Lee Grant, who runs a PC repair shop, reveals his and his customers' most wanted Windows 12 features.

WINDOWS UPDATES

"Windows Updates are great," said no one, ever. Quite a lot of users complain about the updates that seem to plague every Windows 11 restart—it's not just you. Users understand that they're a necessity with a modern OS, but if Windows 12 is going to put a smile on users' faces, then start with the top two things on the wishlist.

First, bring back the option to exclude certain updates. Second, make it simpler to prevent Windows from updating the drivers for specific components. It's possible to manage both through a complex combination of Registry hacks and goat sacrifices, but this is hardly something that's user-friendly. Microsoft can score some simple brownie points by giving Windows 12 users much more control over their updates.



OneDrive

Turn On Windows Backup

Automatically save your Desktop, Documents, and Pictures to OneDrive so you can keep them protected and access them from anywhere.

Remind me again in:

1 Week

30 Days

OneDrive has a lot going for it, but we don't need it pushed down our throats.

ONEDRIVE

Microsoft is trying to force-feed OneDrive to us like we're geese in a foie gras factory. There's a lot to love about Microsoft's cloud offering, but only if you know what it does. Customers feel tricked when an innocent mis-click uploads files from their machine, and experience a heart-attack moment when they find that their Pictures folder is empty. Microsoft makes reversing this process cryptically non-intuitive, as OneDrive is its Hotel California (you can download any time you like, but you can never leave).

To make things worse, especially for 5GB freebie users, OneDrive doesn't look ahead to calculate if there's enough free capacity, only working out that it's full when nothing else can be pushed through the door. Logically, this is as sensible as only realizing that you can't eat another slice of pizza once you've been sick on the floor.

This is doubly annoying for Outlook.com users who don't realize that OneDrive relates to their mailbox capacity, so once OneDrive is full, their incoming emails bounce back. Users tell me that they would like the option of an offline Windows experience, unconnected to the cloud, with no nagging. However, it's more likely that Joe Biden will become the next James Bond than Microsoft introducing this option into Windows 12.

THE UI

Where do I begin? To most of my customers, Windows 11 is Windows 10 with a bad facelift. Aesthetically, it's fine, but its functionality drives my customers insane. Want a Desktop shortcut for your favorite Start menu app? It will take a while to work out how to do it. Need that quick right-click context option? Tough! It's been hidden behind 'Show More Options'.

So here's my request for Windows 12: make it clear how ARM fits in with your strategy. Commit to a decade of support. Extol the benefits, and don't worry about what AMD or Intel might be whispering behind closed doors. Commit, damn it. *TD*

A 21ST-CENTURY FILE SYSTEM

It's been a long time since Windows had a proper update to its file system, and frankly we're overdue. Linux users get to enjoy ext4 and ZFS, with powerful journaling and snapshot capabilities built in, while I'm still stuck here in Windows trying to work out which process is blocking me from deleting the file on my desktop. A mature OS needs a robust and versatile file system—and while we're at it, can we also sort out the directory structure? I very much don't need every application I install to spatter its components across 50 different folders and Registry locations. The Mac has been managing this much more neatly for more than 20 years, with applications that mostly install into a single directory; Microsoft really has no excuse for not having caught up. *DGS*

Why install Xbox apps when most users don't own an Xbox?

FULLY SANDBOXED APPLICATIONS

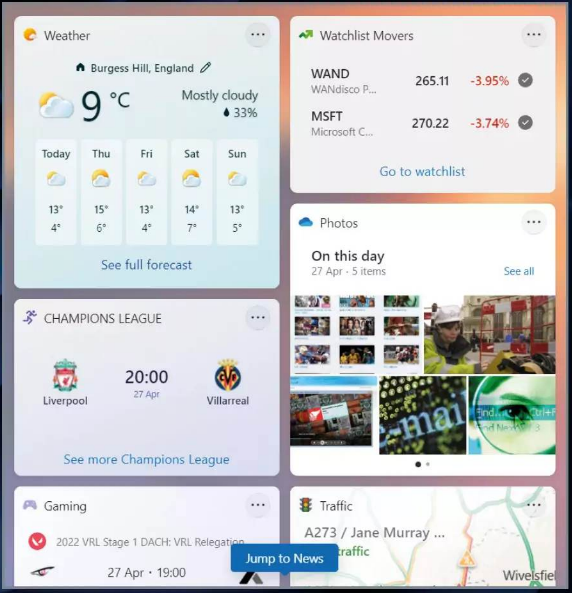
Windows RT was mostly a terrible idea, but it got one thing absolutely right: every RT app ran in its own individual sandbox. The same applies to Windows Store apps today, but it's high time the principle was extended to all desktop apps. This is hardly a radical idea—businesses operate containerized servers and virtual desktops as a matter of course. Microsoft's own Xbox consoles run games in virtual machines that can be instantly suspended and managed from the main dashboard. As well as closing off any

But that's not as bad as Widgets. Customer muscle memory means that they're still clicking the bottom left-hand corner, which launches Widgets, displaying the very best Bing-powered clickbait that someone is desperate to make money from.

A favorite shortcut recently removed without user permission was the 'Show desktop' slice at the right-hand side of the taskbar. This is now the home for Copilot, which is Microsoft's version of Call My Bluff. When I asked Copilot to "Show me the desktop", it replied: "'Sure. Would you like me to open File Explorer app for you?" My customers will be thrilled that their Windows 12 laptops will possess a dedicated Copilot key in order to be misguided at the push of a button.

For long-term users, the slow eradication of the Control Panel has been particularly annoying, especially in the Devices and Printers department, but as some Windows features seem to merge, others are becoming more disparate. Some of my customers who have additional visual requirements hope that Windows 12 will bring an intuitive and cohesive experience to simple tweaks, such as text resizing and contrast manipulation.

Customers groan at the visual disconnects between the OS and apps. For example, increasing the default text in Windows doesn't automatically adjust the same in Office. A blind customer recently told me he's never been able to efficiently use Windows without third-party accessibility software. I've been told that Microsoft has made successful strides in improving the accessibility of Windows, but Windows 12 needs to bring better tools into the core product as part of the standard development, and not as a bolt-on.



Weather
Burgess Hill, England
9 °C Mostly cloudy 33%

Today	Thu	Fri	Sat	Sun
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4°	6°	4°	7°	5°

Watchlist Movers

WAND WANdisco P...	265.11	-3.95%
MSFT Microsoft C...	270.22	-3.74%

CHAMPIONS LEAGUE
Liverpool 20:00 27 Apr Villarreal

Photos
On this day
27 Apr · 5 items

Gaming
2022 VRL Stage 1 DACH: VRL Relegation
27 Apr · 19:00

Traffic
A273 / Jane Murray ...

Widgets: Bing-powered clickbait that someone is desperate to make money from.

WINDOWS S MODE

What do you think the 'S' in Windows S mode represents? Safety? Security? Well, to be frank with you, 'st' is the most common one I hear. For the uninitiated, Windows S is a laughable version of the operating system that only installs apps from the Microsoft Store, and my customers have repeatedly told me that they hate it.**

Step into a customer's shoes. You unbox your new laptop, go through the setup, and feel pleased with your new purchase—until that downloaded driver refuses to install. The printer software also fails, like the accounting package for your side-hustle. Little wonder that the next time I see the customer, they're shouting at me for selling a faulty machine.

The awareness of S mode is so low that the average user doesn't know what it is or how to ping the free upgrade to Home. My customers have suggested that Windows 12 S should be an opt-in downgrade (definitely a downgrade) and not the default, which makes much more sense.

Wouldn't it be nice to set and forget backups, as you can in macOS?

number of vulnerabilities, moving our applications into VMs would give us the power to easily migrate between computers and Windows versions, and to throttle any apps that were eating up resources—finally putting us in proper control of our own systems. *DGS*

SMART PERFORMANCE

More than anything else, I want Windows 12 to perform. I want the quintessential greased-rat-out-of-a-wet-drainpipe experience that has been missing for years. Windows 10 and 11 were quick because of the rise of SSDs, not because of optimized coding. How do I know? Sitting to my left is a Windows 10 laptop sporting an AMD A4 chip with 4GB of RAM and a 64GB eMMC. If I switch it on now, it may have booted by Christmas. I want Windows 12 to fly on these sorts of low-powered machines by using smart optimization and hardware compensation.

Windows 12 should have a select core of features, and only download guff on user demand. Why does this A4 have the Mixed Reality Portal app auto-installed when the hardware is inadequate? Why does Windows install with multiple Xbox apps when most users don't own an Xbox?

Younger readers won't remember a time when Windows was quick, but to my right is an 18-year-old XP machine with a single-core CPU, 512MB RAM, and an 80GB PATA drive, and it flies. Admittedly, it's almost useless, but it's a reminder that users used to manage with much less. Microsoft needs a *Rocky 3*-like montage to thrash Windows 12 until it re-emerges, lean and oiled, looking like a genuine contender. *LG*

AVOID THE ONEDRIVE LOCK IN

With Windows 12, it's likely that we'll see tighter integration between Windows and Office, with the clear push to moving to one subscription for both. Microsoft also pushes users very hard to use OneDrive. Depending on your installation, OneDrive is made the default storage space for Windows, with a redirect of Desktop and document folders into a OneDrive tree, rather than the more usual local storage space.

This is especially notable within Office itself, where File/Save As will take you to a OneDrive storage window first. From this, you can choose to go to 'Local Files' if you want to use a local drive or a local network store, such as a NAS. At least on Office for Windows, you can override this setting and force Local Files as the default. However, this isn't possible on Office for Mac.

I would like to see Windows 12 take a more open approach to storage, and to stop trying to force OneDrive on users, both within Windows itself and inside Office. There's nothing wrong with OneDrive, and it's a good default for many users. But it isn't necessarily the best fit for all, and getting out of the default configuration can be tiresome. *JH*

Repair & support

PROPER REPAIR/ REINSTALL OPTIONS

I'd love to see a proper diagnosis and repair suite for Windows 12. There are too many occasions when the only repair option for Windows is to erase and start over. I've spent years bashing DISM strings into command windows, and despite having a workshop full of tools and tricks, too often I'm forced to admit defeat.

Windows is great at resolving 'coughs' that occur from time to time, but when a major mishap brings out the BSODs, it loses its mind. System Restore points go missing and update rollbacks fail, declaring, "We've encountered a problem". It really isn't good enough. In extreme cases when a reset is required, Windows 12 users would benefit from an Internet Recovery mechanism like Apple has utilized for many years. In the past, a procedure called Repair Install was possible on non-booting machines, which could get systems off their knees and stop them crying. Repair Installs are possible in Windows 11, but only if the machine starts correctly. Windows 12 needs to break this Catch-22 madness. *LG*

WINDOWS 12 LTS FOR ALL

Microsoft does release LTS (or long-term service) versions of Windows 11, but only Enterprise licence customers have access to them. What I'd like to see is something more akin to Ubuntu's release schedule, with an LTS available to all every two years, and six-monthly updates for those that want them.

Stability is everything for a day-to-day working PC. I'd be happy if Microsoft nailed down LTS versions for three years and kept the feature updates on an annual cycle, so that there's less disruption all round. A guarantee that nothing serious is going to change (and possibly break) for three years would give me much more confidence to upgrade to Windows 12. *BC*

PROPER BACKUP AND SYSTEM TRANSFERS

Backup is easy on a Mac: give access to a drive, set it up as Time Machine, and then a rolling, almost real-time backup is done of the whole computer. All your files, all the

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system settings. Recovery is simple, either for a file or folder, or a whole machine. Transferring yourself from one computer to a new one is a matter of a few mouse clicks.

It's time that Windows 12 supported a similar solution, especially for the home, SOHO, and small business user. It shouldn't rely on third-party apps to work, and it's an issue with all versions of Windows up to Windows 11.

I accept that full machine recovery, especially from one vendor to another, can be fraught with driver issues, plug-and-play storms and all sorts of unpleasantness. But this is 2024, and I'm tired of the excuses.

While we're at it, it should be possible to boot any Windows machine directly from the internet, too. This can bring down the entire operating system and install it for you. Again, this is incredibly easy on a Mac. It's about time Windows 12 supported something similar. *JH*

CLASS-LEADING REMOTE ACCESS AND SETUP

The remote-access market is vast, with over 30 products vying for attention. Some of them are gold-plated, super-expensive corporate support tools; others will take money from ransomware pirates, giving them an easy route into the victim's computers and data. The time has come to thin out this marketplace, both because of the—ahem—spread of moralities in suppliers, and because the operating system is the right place to conquer the twin issues of traversing the infrastructure and securing the little roaming device that inevitably is the one needing the support. It's about time that having a Microsoft ID actually delivered some benefit to the user, and this is the right job to realize that dream. *SC*

Business & security

MORE TIMELY SECURITY UPDATES

There's no denying that Windows is a code behemoth, and that's a bad thing from a security perspective. I'm not talking about more code meaning more potential for vulnerabilities, but rather the way that code is structured makes implementing security updates a bigger pain than it should be.

Instead of the Windows system living on one writable partition, it would be great if Windows 12 adopted a state-separated approach. This modular design, which rumors suggest is being developed as 'CorePC' by Microsoft, would have multiple secure partitions with encrypted user data accessible after logging in. Core system data and user data would not reside on the same partition.

Moving system files required for boot-up to a read-only partition that can't be modified by apps or users is a security advantage. Perhaps less obvious is that by separating OS, apps, and data, you can have faster and more stable updates.

While the idea of Patch Tuesday—all security updates available on a given date to allow for better planning—is good, it could be complemented with rolling security updates. Because only the applicable partition is updated, this means that rolling back the system to a pre-updated and stable state should be faster and easier, negating much of the reason for Patch Tuesday in the first place. *DW*

BUILT-IN PROTECTION AGAINST RANSOMWARE ATTACKS

I'm thinking about smaller businesses, not well-supported enterprises. I'm thinking about a mix of cloud backup and cloud sandboxing, so the bad guys can't stop you working.

Plenty of enterprise backup toolkits include the ability to keep a cloud-resident version of your laptop's sandbox VM workspace in sync with the roaming version. This achieves practical protection against ransomware, but requires a cool head when populating the device with logins and passwords; a competent ransom attacker will gain control of the account used by the innocent worker, so the continuously updated VM must be logged in and active under another user and password combination.

The remediation process after the infection and ransom process must be simple. Sandboxing ought to mean that the 'survivor' twin of the VMs that were attacked is just as runnable once re-downloaded to the laptop as it is on its usual environment in the Microsoft cloud. It's not a good idea to escape ransomware and then get stuck running the at-risk environment on expensive cloud-hosted servers. Microsoft is the only player that can own all these pieces and make them stick together coherently. *DW*

–CONTRIBUTORS: STEVE CASSIDY, BARRY COLLINS, TIM DANTON, DARIEN GRAHAM-SMITH, LEE GRANT, JON HONEYBALL, NIK RAWLINSON, DAVEY WINDER

YOUR PERSONAL FILES ARE ENCRYPTED
Make payment or private key will be destroyed in
12 Hours 01:34

More protection against ransomware, if you don't mind.

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CENTERFOLD

Hyte Thicc Q60

WHAT can we say about the Hyte Thicc Q60? At its core, you might be thinking that it's just another CPU cooler. It's not some grand graphics card capable of flinging thousands of frames a second to your monitor, and it's not some wonderful OLED panel, crisp and complete with a low-enough latency to make your eyes bleed. It's a cooler. It cools things.

But the thing is, PC building has come a long way. When AIOs first debuted on the scene, you were lucky if your water block was illuminated with an LED. Today, LCD screens litter them a dime a dozen. It takes a lot to stand out from the crowd and make a name for yourself. And so too is the case for your own build. Why settle for average when you can have epic? Why compromise with generic when you can have phenomenal?

That's where the Hyte Thicc Q60 comes in. From the brilliant minds behind iBuyPower's effective Skunkwork division, this all-in-one liquid cooler challenges the status quo, and blows the barn doors right off, bringing the category into the modern era. Hyperbole? Probably. But nonetheless, this thing is an absolute king. – **MAXIMUM PC**

1 PIXEL DENSITY KING

Of course, the Thicc Q60 also comes with its own dedicated display, similar to the Y70 Touch. This one though, is a five-inch IPS display, complete with 720x1280 resolution, 60Hz refresh rate, and a pixel density of 293. It's three times denser than a 24-inch 1080p panel.

2 TWIN CPU PUMPS

Yep you read that right, there's two dedicated pumps in this wee beauty, running at a phenomenal 2,000 - 4,500rpm. Both are optimized with sound dampening in mind, to not only drive that heat straight into those radiator fins, but also stay silent as they do so.

3 STATIC POWER

Seriously, these 120mm fans are dragon-level threats, producing no less than 8.14 mmH2O of Static Pressure at full tilt. For comparison, Noctua's NF-F12 industrial editions max out at just 7.63 mmH2O. That's in no small part thanks to the 32mm fan thickness.

4 STANDALONE DOOM

Yep, it's even got 2GB of DDR4 running @2,666 MT/s along with two processors, and 32GB of eMMC storage too. Honestly, if someone doesn't get *Doom* running on this then something's gone terribly wrong.

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A BRIEF HISTORY OF CYBERWARFARE

Digital battlegrounds are hard to quantify; attackers are faceless and their weapons often untraceable. Nate Drake delves into the world of cyber espionage and sabotage

"THE WARS of the future will not be fought on the battlefield or at sea. They will be fought in space, or possibly on top of a very tall mountain. In either case, most of the actual fighting will be done by small robots."

This prophecy by the military school commandant in the Season Eight finale of *The Simpsons* has yet to come true. 'Kinetic' warfare is very much the norm, with battles being decided by who has superior guns, missiles, and aircraft.

Still, in recent decades, a very different type of war has emerged in cyberspace. Though nations don't exclusively use small robots to attack others, they're not above employing teams of hackers to try to steal proprietary information, sabotage enemy infrastructure, and carry out surveillance of foreign nationals.

Not all countries do this. Cyberattacks can also be carried out by bad actors with no political affiliations. This means there's no single universally accepted definition of cyberwarfare. In 2013, NATO even published a video entitled *Cyberwar - does it exist?* It contains an interview with Dr Thomas Rid, an expert on the history and risks of IT in conflict.

Rid argues that cyberattacks of the kind that briefly crippled key Estonian infrastructure in 2007 were not considered warfare by the country's government, even though they suspected the Kremlin was to blame.

Still, if we understand cyberwarfare to mean the weaponized use of computer networks to attack others in an enemy state, then this is a conflict that has raged on for decades.

HOW IT ALL BEGAN

In 1986, astronomer-turned-computer engineer Clifford Stoll was asked to resolve an accounting error of 75 cents at the Lawrence Berkeley National Laboratory (LBNL). High-speed computers were costly, so students and researchers would often dial in to LBNL's mainframe, for which they were billed using specialist computer programs.

Stoll quickly realised that an unauthorized user had connected to LBNL's network for nine seconds of unbilled time. This was some time before the modern internet—although academic institutions could dial each other without too much trouble, the wider world had to make use of external phone lines. If you were based outside the USA, this could result in huge international toll charges.

To spare early internet users' pockets, routing services like Tymnet could provide local numbers for your modem to dial, then connect you to an organization based in another country via packet switching.

Toll worked out that this was how the hacker was connecting to LBNL. The type of commands he was running also meant

TEISES
MAAILMASÕJAS
HUKKUNUTELE
ПАВШИМ
ВО ВТОРОЙ
МИРОВОЙ ВОЙНЕ

The 2007 Estonia cyberattacks began shortly after the decision to relocate the Soviet-era grave marker, 'The Bronze Soldier of Tallinn'.

it was unlikely he was from Berkely, who had their own version of UNIX. He connected a series of teleprinters to various lines around campus to record the hacker's activities. This revealed a pattern of brief connections coupled with searches for keywords like 'nuclear' and 'SDI' (Strategic Defense Initiative).

Stoll saw that this hacker was interested in state secrets, as the LBNL connection would often be used to try to access other networks, such as those at military bases. Getting law enforcement to agree that the threat was real proved harder. The FBI declined to intervene, as there was no proof that large sums of money had been stolen. Through a combination of camping out in his laboratory, hounding various government agencies, and technical trickery, Stoll was able to trace the connection to West Germany. Internet access was managed by Deutsche Bundespost, who ultimately found one Markus Hess, who had been selling hacked data to the KGB for years.

This is one of the first documented cases of cyber espionage, and as Stoll notes in his 1989 book, *The Cuckoo's Egg*, it highlights how lackadaisical both government and academic institutions were about cyberwarfare. At various times, he had contact with the CIA, NSA, FBI and various branches of the Air Force, but initially they all claimed the matter fell outside their 'bailiwick'.

The popular VAX series of computers of the time also came with three default user accounts with the preprogrammed passwords MANAGER, SERVICE, and USER. This made them eminently hackable, given that many system managers didn't bother to change them.

As disastrous as this breach was, this act was carried out by a private citizen. The Russian government didn't engage in cyberwarfare directly. For this reason, the 1988 Morris Worm, one of the first distributed over the internet, doesn't amount to cyberwar. The worm was the work of programmer Robert Morris, who claimed to have designed it as a proof of concept. The fact that it cost academic institutions millions to disinfect their machines was not due to enemy action.

Still, the Morris Worm underlined the fragility of the internet in the late eighties. The Worm had been programmed to try to infect machines 14 percent of the time, even if the device was already infected.

In the epilogue to *The Cuckoo's Nest*, Stoll noted that this underscores the danger of relying on any one operating system: "If all the systems on the ARPANET ran Berkeley Unix, the virus would have disabled all 50,000 of them."

INTERGRAPH
36
VAX 8550

VAX/VMS machines were extremely popular with academics, but few bothered to change the default passwords.

In Stoll's case, the act of cyberwarfare he investigated was well documented. Other incidents proved more murky. In Thomas C Reed's *Into the Abyss*, he documents his time with the Lawrence Livermore National Laboratory (the sister site to Stoll's LBNL). Reed claims that during his time as an adviser to President Reagan, the CIA became aware of spying by the USSR. He goes on to say that Russian spies were allowed to steal pipeline control software, as the CIA had deliberately infected it with a trojan virus.

This supposedly resulted in a pressure test running at twice the maximum safe limit, causing a massive explosion in the Trans-Siberian pipeline in 1982. If true, this would have dealt a devastating blow to the Soviet economy. Still, as Reed notes, this first act of cyberwarfare would also have had a profound psychological impact: "By implication, every cell of the Soviet leviathan might be infected."

Sadly, there's no neat ending to his story, given both the US and Russian governments denied that the pipeline ever exploded. Subsequent investigations have also cast doubt that pipeline workers in 1982 would have relied solely on software for pressure checks. If *Into the Abyss* is to be believed, the aforementioned Soviet leviathan was far from defenseless. On July 25 1999, the UK's *Sunday Times* ran the provocative headline, 'Russian Hackers Steal Weapons Secrets'. The story went on to claim that Russian threat

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Software for modern gas and oil pipelines can be sabotaged with devastating effects.

actors had been stealing US military secrets for years.

The US government first realized that something was amiss in 1998 after a technician at specialist materials company ATI-Corp noticed that one of their administrators seemed to have connected from the corporate network to Wright-Patterson Air Force Base. After the account holder confirmed that he wasn't online at the time, the technician raised the alarm with a number of CERTs (Computer Emergency Response Teams).

In the late '90s, the US government didn't have a coordinated department for tackling cyber crime, but the FBI started their own investigation entitled 'Moonlight Maze'. They quickly discovered this cyber attack was on an unprecedented scale.

Nothing was off limits to the hackers, who compromised institutions like the US Army, as well as various research laboratories. Organizations in the UK, Canada, and Germany were also targeted.

Although the FBI uncovered a direct connection from Moscow, in most cases the attackers deployed proxies via colleges and small businesses. After this, they'd used standardized tools like Telnet and FTP to try to access sensitive data.

One of the hacked proxies was a Solaris server based in the UK. After discovering the attackers' methods, the FBI worked with the London Metropolitan Police to reconfigure the machine (nicknamed 'HRTest') to log all keystrokes.

The hackers didn't help themselves by using machines they infected to search for other vulnerable machines on the same network. As in most cases, said machines had been loaded with 'sniffer' malware, and the attackers inadvertently created logs of nearly all their activity when targeting systems. This allowed the Feds to observe the hackers' activities and identify which organizations they were targeting. But there was no definitive evidence that they were based in Russia.

In *Rise of the Machines: A Cybernetic History*, Thomas Rid documents the steps the FBI took next by creating a 'honeypot' document. Hackers were allowed to steal this, unaware that upon opening it would initiate a DNS request to a server owned by the investigators. This provided clearer proof that the attackers were based in Russia. The FBI also noticed that these same hackers never launched attacks on Russian Orthodox holidays, and systems were usually targeted during the working day in Russia. A team was even dispatched to Moscow, but there's no record of the Kremlin assisting with the investigation.

Further investigation revealed that thousands of sensitive (albeit unclassified) documents had been stolen, with the first attacks being traced back to 1996. Moonlight Maze, therefore, marks one of the first known occasions when one state engaged in all out cyberwar with another.

Unfortunately for the USA, there was little respite, as China decided to enter the fray in 2003. This act of cyberwarfare, codenamed 'Titan Rain', consisted of a series of coordinated attacks against organizations like the US DIA (Defense Intelligence Agency), FBI, NASA, and even the UK's Ministry of Defence. It wasn't initially clear where the attacks originated. At the time, Chinese servers were notorious for being poorly secured, allowing hackers to exploit them.

The FBI first suspected a state actor due to the precision behind the attacks. The threat actors' MO was largely the same—first, a trojan virus would compromise the target system. The attackers would then take over a small portion of a system's hard drive and begin compressing files to ZIP format. These would be transmitted to servers in South Korea, Taiwan, and Hong Kong. The attackers made a point of deleting all traces of their activity, with the exception of the trojan, which they could use to re-enter the target system. As the files were being transmitted to Asia and mainly owned by US defense contractors, it was clear China would benefit. Further investigation showed that the three primary routers to which data was transmitted were based in Guangdong Province.

After the attacks became public in 2005, the Director of the SANS institute, which specializes in cybersecurity, opined that only a military organization could carry out such precise, coordinated attacks. The US Government was quick to point the finger at the PLA (People's Liberation Army). To date, they've yet to release any hard evidence of these claims.

This underscores the difficulty of attribution when it comes to cyberwarfare. Cybersecurity expert James Lewis argues that even at the turn of the century, Chinese government hackers were sufficiently skilled to hide the digital trail of their activities.

Stuxnet targeted Iranian industrial systems like those used for gas centrifuges.

Wright-Patterson AFB was one of the Moonlight Maze targets.

U.S. AIR FORCE
0044

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LET THE GAMES BEGIN

Uncle Sam is no slouch at cyberwarfare, as evidenced by 'Operation Olympic Games', a supposed collaboration between Israel and the USA to carry out cyber attacks on Iranian nuclear facilities.

In 2010, a worm infected the Bushehr nuclear power plant in Iran. The cyberweapon, 'Stuxnet', hit computers linked to Siemens industrial systems. At the time, Iran used embargoed Siemens equipment at various nuclear facilities.

The worm's payload was designed to target SCADA (Supervisory Control and Data Acquisition) systems. These PLCs (Programmable Logic Controllers) automate electromechanical processes like running gas centrifuges. Once infected, the PLCs could be programmed to run until the machine tears itself apart.

Symantec suspected a state actor due to Stuxnet's sophistication. The worm's PLC injection code targeted the control systems used by Iran. The second component was a link file to automatically execute Stuxnet itself, and contained a rootkit inside a fake DLL file to block detection. Stuxnet also contained multiple 'zero day' exploits—most unusual for malware crafted in the wild.

Symantec discovered that this wasn't the first shot fired in the cyber war against Iran—a version of Stuxnet had been deployed as early as 2007 against Iran's uranium enrichment facility.

Perhaps the most telling evidence that Stuxnet was a cyberweapon is the fact that if specific Siemens software wasn't found on an infected computer, the worm would stay idle. The greatest portion of infected computers (60 percent) were also in Iran.

Despite the clear advantage to Israel, the US and their allies, no official confirmation has ever been published about Stuxnet. However, in May 2011, the PBS program *Need to Know* quoted a statement by White House Coordinator for Arms Control and WMDs, Gary Samore: "We're glad they [the Iranians] are having trouble with their centrifuge machine and that we—the US and its allies—are doing everything we can to make sure that we complicate matters for them."

Although Iran's nuclear program was set back, the developers of Stuxnet clearly made an effort to focus on legitimate military targets, leaving civilians unharmed. This distinction is lost on Russia, which has been engaging in both kinetic and cyberwarfare against Ukraine.

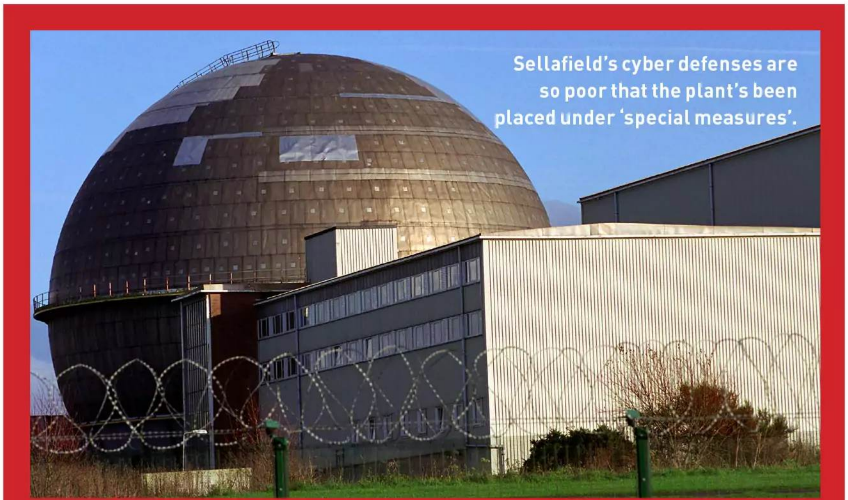
In the run-up to the invasion in 2022, a number of Ukrainian government websites went offline, only to reappear briefly with a message telling citizens to 'Prepare for the worst'. Ukraine's SBU security service claims to have neutralized 1,200 such attacks in the previous nine months.

At the same time, Microsoft's Security blog reported on a new form of malware that was spreading on Ukrainian government devices, dubbed 'Cadet Blizzard'. The blog claimed this was clearly 'nation-state actor activity', given how it masqueraded as ransomware.

Cadet Blizzard overwrites the Master Boot Record on computers to display a 'ransom note'. The malware destroys the MBR and any files it can access—it is designed to disrupt, not extort. In February 2022, two DOS (Denial of Service) attacks knocked the websites of Ukraine's army, defence ministry, and two private banks offline. The UK government concluded Russia's GRU were responsible.

This did little to hamper Ukraine's war efforts. But on February 24, the Viasat KA-SAT network was targeted by sophisticated 'wiper' malware. This knocked a number of satellite modems offline, including those used by Ukrainian military and government departments.

To date, cyberwarfare hasn't directly caused any deaths, but if nation states continue to develop more powerful cyberweapons and attacks, it could only be a matter of time. Initiatives like the Tallinn Manual have established a practical and legal framework for cyberwarfare for NATO countries. Unfortunately, not all non-NATO members have been as forbearing, as APT (Advanced Persistent Threat) groups have targeted institutions like banks, as well as power grids.



Sellafield's cyber defenses are so poor that the plant's been placed under 'special measures'.

POWER KO

During the Viasat attack, hundreds of wind turbines stopped functioning. Although they weren't the intended target, such attacks reveal how cyberwarfare can badly disrupt a country's energy supply.

The Guardian **demonstrated this in December 2023 after revealing that the UK's most hazardous nuclear site, Sellafield, had been targeted by hackers. The paper claimed that senior officials at the plant tried to cover up the attack, as malware breaches were first detected in 2015.**

Although the implications for data theft are serious, Sellafield also has a large stockpile of plutonium and regularly disposes of nuclear waste, both of which could be devastating in the wrong hands. Additionally, the official investigation apparently revealed that the plant's control systems were so vulnerable to attack that they should be replaced immediately.

At the time of writing, no culprit was found, but Russia seems to have no issue targeting other nations' power supplies. In November 2023, Ukraine's SBU confirmed that Russian hacking group 'Sandworm' had disrupted part of the country's power grid in late 2022. As with Stuxnet, the attack focused on industrial control systems, in this case by tripping circuit breakers at a substation during a missile strike.

Sandworm previously launched an attack on Ukraine's power grid in 2015, knocking out power for over 250,000 people. This was one of the first successful attacks against a power network, which when combined with conventional weapons, makes Russia a deadly player in the ongoing cyberwar.

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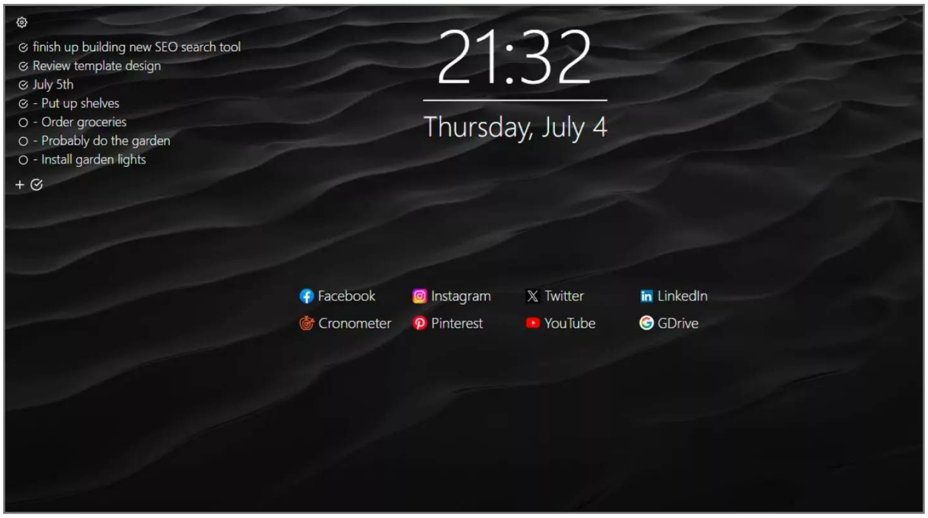
HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

TIP OF THE MONTH



☑ finish up building new SEO search tool
☑ Review template design
☑ July 5th
☑ - Put up shelves
○ - Order groceries
○ - Probably do the garden
○ - Install garden lights

21:32
Thursday, July 4

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TABLISS FOR CHROME

Fed up with the generic new tab page on Chrome? Fortunately, there are a ton of extensions out there that'll help throw a load of new features into it, including customizable backgrounds, lists, clocks, links, and more. Tabliss is our favorite at Maximum PC. It's free, easy to tweak, and insanely helpful for anyone who struggles to keep on top of their daily tasks. https://tabliss.io

MAKE – USE – CREATE

60
Transform your life with ChatGPT

64
Fix issues with Windows Repair

68
Securely delete Windows files

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ZAK STOREY
CONTRIBUTOR

DIVING INTO BENCHMARKING

I've been dabbling with laptop benchmarking. Unlike on a desktop PC, you often don't have clean-cut comparisons. Take gaming laptops—some have 16:9 displays, some 16:10, and others bizarre resolutions (2880x1800, anyone?). It makes testing a little haphazard.

I think I've settled on a system. I perform one set of tests at that laptop's native resolution, then another round, forcing the laptop to operate at 1920x1080. That might seem counter-intuitive, particularly given some of them are packing RTX 4090s, but it gives us a baseline to compare them on. Then, of course, we can look at native resolution performance in isolation, comparing the resolution and its performance against itself.

Even at 1080p, these 15- and 16-inch panels look and perform great. I recently picked up a Steam Deck OLED handheld, and was amazed at how well the integrated hardware handled games like *Cyberpunk* and *Red Dead Redemption 2*. I hadn't considered how low a resolution that thing runs—1,200x800 res on a 7.4-inch display. That's a PPI of 194 or so, a lot higher than 4K at 32 inches, but it looks flawless. It shows how important PPI figures can be, particularly on more portable devices.

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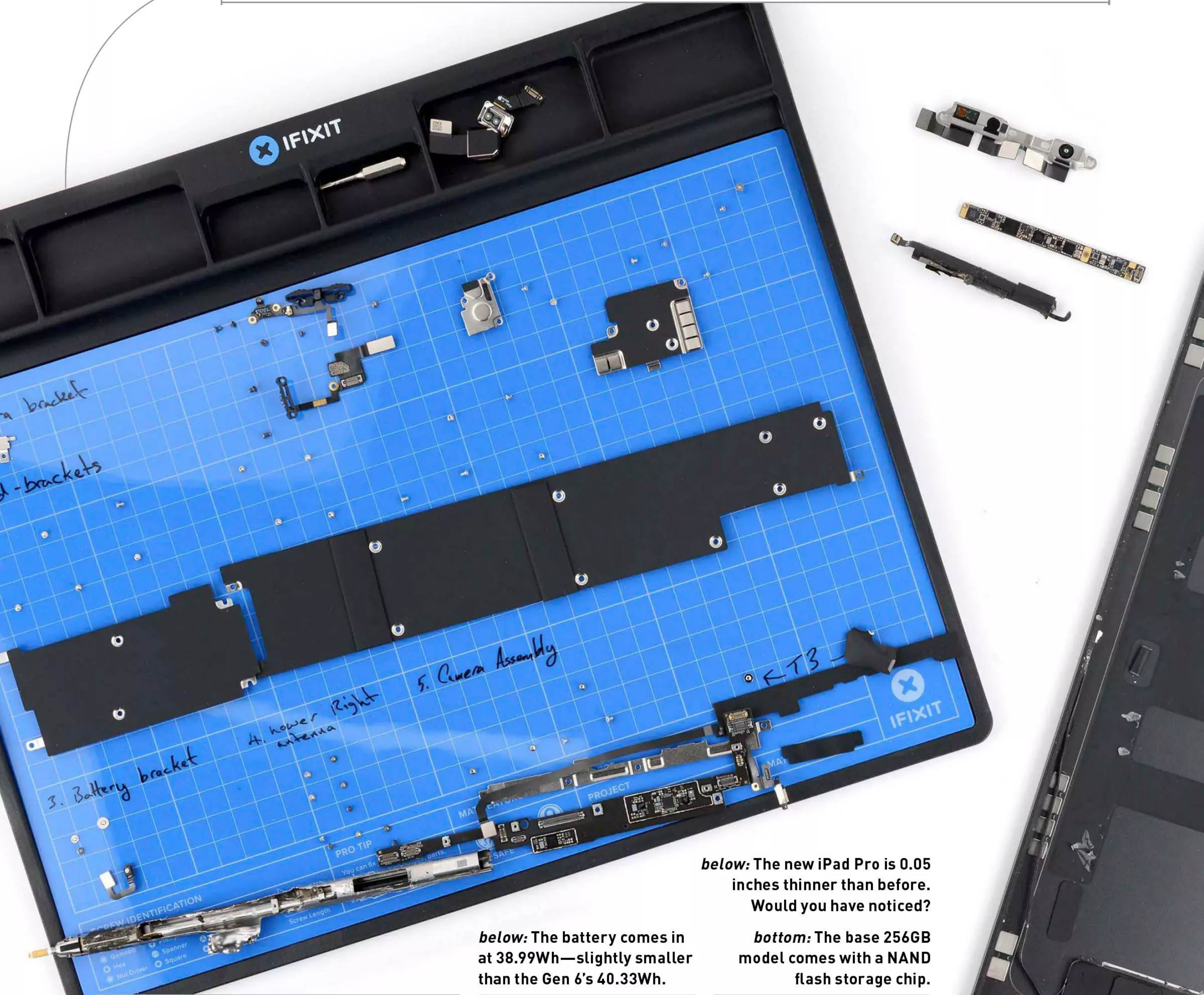
AUTOPSY

THIS MONTH WE DISSECT...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3. Battery bracket
4. Lower Right antenna
5. Camera Assembly
← T3
PRO TIP
SCREW IDENTIFICATION

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com

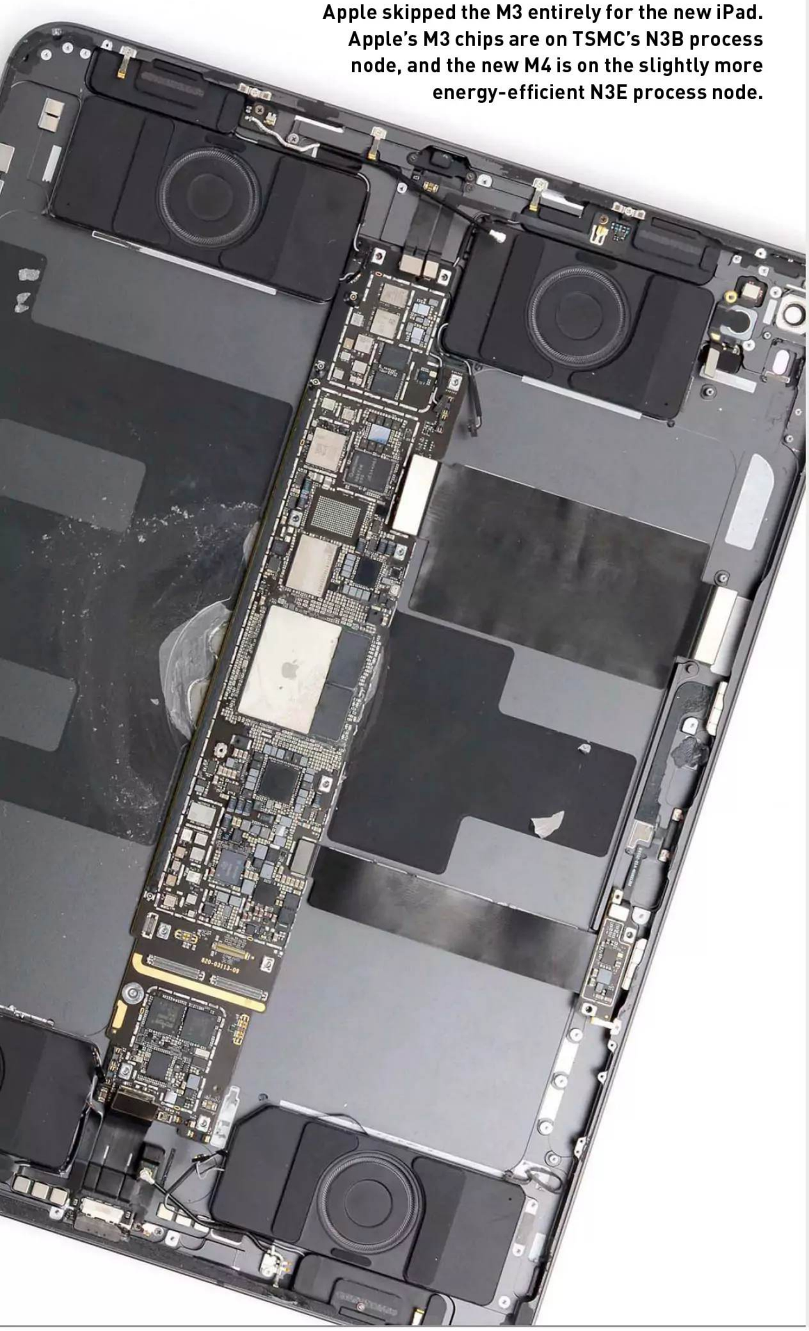
below: The battery comes in at 38.99Wh—slightly smaller than the Gen 6's 40.33Wh.

below: The new iPad Pro is 0.05 inches thinner than before. Would you have noticed?

bottom: The base 256GB model comes with a NAND flash storage chip.

Apple iPad Pro 13

Apple skipped the M3 entirely for the new iPad. Apple's M3 chips are on TSMC's N3B process node, and the new M4 is on the slightly more energy-efficient N3E process node.



BACKGROUND

New 3nm M4 chip, tandem OLED, and ultra-thin. Say what you want about the new Apple iPad Pro, but it's absolutely cutting edge. So what's it like inside?

MAJOR TECH SPECS

- M4 SoC with up to four performance and six efficiency cores, 10-core GPU and 16-core neural engine
- 13-inch Tandom OLED display, 2,752 x 2,064 pixels, 1,600 nits HDR
- 12MP Wide camera, ƒ/1.8 aperture, digital zoom up to 5x, up to 4K 60Hz video
- Up to 16GB memory and 2TB storage
- 5G (sub-6 GHz) with 4x4 MIMO7, Gigabit LTE with 4x4 MIMO and LAA7, Wi-Fi 6E with 2x2 MIMO8, Bluetooth 5.3
- Thunderbolt / USB 4 port with support for charging, DisplayPort, Thunderbolt 3 (up to 40Gb/s), USB 4 (up to 40Gb/s), USB 3 (up to 10Gb/s)
- 38.99Wh rechargeable lithium-polymer battery, up to 10 hours of surfing the web on Wi-Fi or watching video

KEY FINDINGS

- First off (pun intended) is the Tandem OLED, a.k.a. Ultra Retina panel. Like its LCD siblings, the internals are only accessible via the screen. The glue holding it down isn't terrible, but this repair is not going to be for the faint of heart. Guaranteed, this Ultra Retina panel is going to be expensive to replace long after the battery starts losing its efficiency. Opening the device will certainly risk breaking it.

- The new panel is an impressive bit of engineering. The Samsung and LG-manufactured Tandem OLED panel provides a peak SDR brightness of 1,000 nits—a significant increase over the SDR brightness of 600 nits on the 6th generation iPad Pro. The contrast ratio has doubled, too, meaning brighter whites and darker blacks.

- For the first time in an iPad Pro, we're able to remove the battery immediately after removing the screen. Well, 'immediately' is relative. There are still some screws and brackets, but this is a major improvement over previous-generation iPads, where a two- to three-hour ordeal saw the logic board and kitchen sink removed before the battery could be accessed. This comes in at 38.99 Wh—slightly smaller than the 6th Gen's 40.33 Wh.

- While we can celebrate this victory, it's inevitable that an even thinner product would come with some unrepairable compromises. From the daughterboard to the speakers and coax cables, we found a whole bunch of stuff that's glued down because there just isn't enough space for screws. That means speakers will get destroyed if you try to remove them, the daughterboard gets bent out of shape if you look at it the wrong way, the heat-sensitive cameras are subject to a risky prying operation to remove, and other shenanigans.

- All this to reduce the thickness by 0.05 inches—nearly imperceptible even if you place the 6th generation iPad Pro 12.9 next to it. Nobody asked Apple for this, and had they not made such a big deal of it, few people would have noticed.

- Repairability Score: 5 out of 10 (10 is easiest to repair). Everyone is already celebrating the technological wonders of this device, but we're also happy to see Apple prioritize repairability a little. It's great to see the battery being designed for accessibility and replacement, yet that victory is soured a bit by the compromises required to create a needlessly thinner device. Perhaps Apple's engineers can innovate themselves toward repairability, even at these extremely tight tolerances.

10 ways ChatGPT can change your life

YOU'LL NEED THIS

CHATGPT-3.5
(free)
CHATGPT-4.0
(from $20)
chat.openai.com

SHORT FOR 'CHAT GENERATIVE PRE-TRAINED TRANSFORMER', it's no exaggeration to say that ChatGPT has changed the world. In this feature, we explain how it can transform your life in some very specific and practical ways. To get the most out of ChatGPT, you'll have to pay. Developer OpenAI offers use of the GPT-3.5 engine for free, and limited access to GPT-4.0, but paying subscribers get full access to the more advanced model. Plans start at $20 per user per month for the personal tier, which also includes the DALL-E image creation tool.

The simplest way to use ChatGPT is through a web browser, directly on the OpenAI website. But a huge number of third-party services have also been built on top of the platform, giving you convenient ways to access specific capabilities of the AI. The problem, as with any digital gold rush, is working out which implementations are actually useful and worthwhile. Here are our recommendations—10 of the best AI applications that really can save you time and enhance your daily life, both at work and at home. –**NIK RAWLINSON**

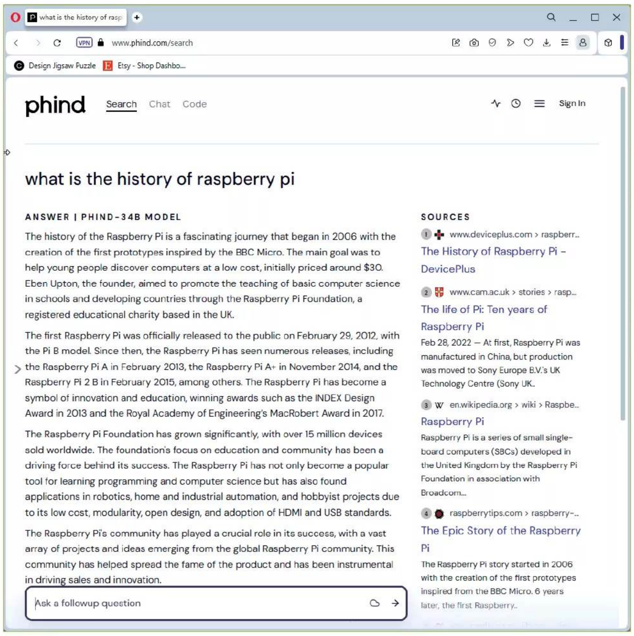
1

MANAGE YOUR EMAIL

Workflow automation platform Zapier (zapier.com) lets you connect ChatGPT to Gmail and other messaging services, including Facebook Messenger and Microsoft Outlook. The AI can then automatically compose replies to incoming messages; when a new email arrives in your inbox, Zapier passes its content to ChatGPT, which writes a personal response. This is then saved as a draft for you to review and optionally edit before dispatch.

» If you prefer to write your own responses from scratch, you can use Zapier to automatically label incoming messages to make them easier to find, extract information from labeled emails, and send details to a Google Sheet for further analysis—or summarize emails as they arrive, so you can quickly decide whether they're worth your attention.

» If you're using Outlook, you can alternatively take advantage of Microsoft's own ChatGPT-based email tools, which can summarize long email conversations—a convenient way to catch up if you've been away—or draft messages on your behalf. Note that this requires an outlook.com, hotmail.com, live.com, or msn.com email address—you can't currently use it with third-party providers, such as Gmail.



what is the history of raspberry pi

ANSWER | PHIND-34B MODEL

The history of the Raspberry Pi is a fascinating journey that began in 2006 with the creation of the first prototypes inspired by the BBC Micro. The main goal was to help young people discover computers at a low cost, initially priced around $30. Eben Upton, the founder, aimed to promote the teaching of basic computer science in schools and developing countries through the Raspberry Pi Foundation, a registered educational charity based in the UK.

The first Raspberry Pi was officially released to the public on February 29, 2012, with the Pi B model. Since then, the Raspberry Pi has seen numerous releases, including the Raspberry Pi A in February 2013, the Raspberry Pi A+ in November 2014, and the Raspberry Pi 2 B in February 2015, among others. The Raspberry Pi has become a symbol of innovation and education, winning awards such as the INDEX Design Award in 2013 and the Royal Academy of Engineering's MacRobert Award in 2017.

The Raspberry Pi Foundation has grown significantly, with over 15 million devices sold worldwide. The foundation's focus on education and community has been a driving force behind its success. The Raspberry Pi has not only become a popular tool for learning programming and computer science but has also found applications in robotics, home and industrial automation, and hobbyist projects due to its low cost, modularity, open design, and adoption of HDMI and USB standards.

The Raspberry Pi's community has played a crucial role in its success, with a vast array of projects and ideas emerging from the global Raspberry Pi community. This community has helped spread the fame of the product and has been instrumental in driving sales and innovation.

Ask a followup question

SOURCES

① www.deviceplus.com › raspberr...
The History of Raspberry Pi – DevicePlus

② www.cam.ac.uk › stories › rasp...
The life of Pi: Ten years of Raspberry Pi
Feb 28, 2022 — At first, Raspberry Pi was manufactured in China, but production was moved to Sony Europe B.V.'s UK Technology Centre (Sony UK..

③ W en.wikipedia.org › wiki › Raspbe...
Raspberry Pi
Raspberry Pi is a series of small single-board computers (SBCs) developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom...

④ raspberrytips.com › raspberry-...
The Epic Story of the Raspberry Pi
The Raspberry Pi story started in 2006 with the creation of the first prototypes inspired from the BBC Micro. 6 years later, the first Raspberry..

» By using AI to search the web, you can get straight answers rather than pages of search results.

© PHIND.COM

2

SEARCH SMARTER

If you're searching the web for specific information, it can take some exploration to find the right terms. For example, if you have a problem with your car, you might first need to research whether the issue lies with spark plugs or glow plugs. You can get better results by swapping your search engine for an answer engine. Phind (phind.com) bills itself as an "intelligent answer engine for developers [that] uses generative AI to get you from idea to solution"—but despite the focus on developers, it's certainly not limited to technical queries.

» You can ask it general questions on any topic, and receive narrative, natural-language responses in reply. All sources are cited and linked so you can explore further, and Phind even suggests possible follow-up questions. Another option is Google's Gemini chatbot (gemini.google.com), powered by the company's AI, formerly known as Bard. It works in the same way as Phind, providing narrative responses to plain-language questions.

» As Google warns, by default, anything you type into Gemini may be monitored by human overseers. But if you want to protect your privacy, you can opt out of this review process by turning off Gemini Apps activity for your account at tinyurl.com/358gemini.

3

GET HELP AND INSPIRATION FOR HOUSEHOLD TASKS

ChatGPT is a high-tech wonder, but it can still help with some very down-to-earth domestic questions. For instance, I asked it: "What can I make with one pound of leftover mushrooms using only store-cupboard supplies?" ChatGPT suggested mushroom pasta, then pulled up a list of ingredients and a step-by-step preparation method, with none of the tangential preamble that is normally found on recipe blogs.

» It's not only in the kitchen that AI can lend a hand. I asked Microsoft Copilot how to fix a push-button toilet that wouldn't flush. It came back with a six-step procedure, along with a link to a YouTube video showing how to remove the old mechanism and replace it.

» Although ChatGPT has access to a vast trove of information, you might need to give it guidance to get the most relevant answers. When I asked Phind what kind of front-door lock was most secure, it replied with reference to some overseas products and reviews—adding 'make your answer relevant to the US' was enough to get it to return information from US sources, including several locksmiths.

4 CODE MORE EFFICIENTLY

Last year, Google revealed it had put ChatGPT through the same coding tests it uses when hiring new programmers—and that the AI had done well enough to land an L3 Software Engineer position, with a salary of up to $241,000. So if you need to write any sort of code, from a simple shell script to a complex bespoke application, AI can almost certainly help.

» What's particularly impressive about AI coding is how effectively the algorithms can translate natural-language concepts into working code. For example, I tried asking WPTurbo (wpturbo.dev) to produce a WordPress script that would prompt the user for a date, then retrieve summaries of any content posted in the following seven days. It might have taken even an experienced programmer an hour or so to knock up the relevant routine, but WPTurbo generated precisely what I needed in a matter of seconds.

» Blackbox AI (blackbox.ai) is another service designed to answer coding questions and produce complete scripts. I tested it by asking it to generate a PHP script to monitor a web page for changes, and send an alert by email as soon as it spots one. The answer appeared in less than a minute.

» Microsoft Copilot is likewise well tooled up for coding. I asked it to 'write a bash script to extract the hexadecimal color values of the first and last pixels in an image without using imagemagick'. It partially fulfilled the brief, providing working code to do just that. My only quibble was that rather than generating a bash script, it actually used Python. Fortunately, it's not difficult to run Python scripts from a Linux command prompt.

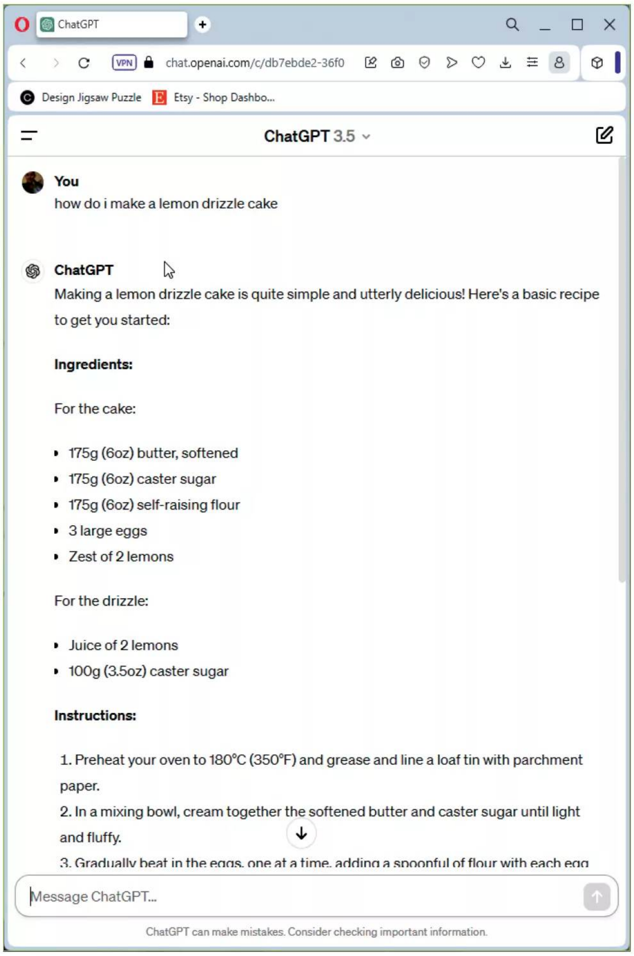
» For professional developers, there's GitHub Copilot (copilot.github.com), which claims to be 'the world's most widely adopted AI developer tool'. A $10-per-month subscription (or $100 per year) gets you unlimited interactions, live code suggestions, debugging, and security remediation assistance. If you upgrade to GitHub Copilot Enterprise ($39 per user per month), it will provide custom suggestions based on your organization's knowledge base.

» In all cases, you should be a little cautious of AI-generated code, and check and test it carefully to make sure it fulfils your brief and doesn't have any concerning quirks. But this can still be a much quicker and more productive way to work than turning everything out by hand—and you can improve your own coding skills by studying how the AI solves your problems and achieves your goals.

5 WRITING WITH AI

Want 100 words of text on any given topic? Just ask ChatGPT. Natural-language generation systems can churn out all sorts of content, from news articles to fantasy fiction. They can't yet replace the human touch: nuanced storytelling, subjective interpretation, and emotional resonance remain difficult for AI to render convincingly, but you can use AI today to help with all sorts of tasks, from job applications to blog posts, presentations, and lengthy project proposals.

» Canva's Magic Write (canva.com/magic-write) is one OpenAI-powered tool that can turn keywords into copy, draft long-form articles, extend and develop existing text, or condense it into concise summaries. Perplexity (perplexity.ai) is another AI tool that can be particularly handy for those who work on the web, as its Chrome extension can automatically grab and process the text you're looking at in the browser.



You
how do i make a lemon drizzle cake

ChatGPT
Making a lemon drizzle cake is quite simple and utterly delicious! Here's a basic recipe to get you started:

Ingredients:

For the cake:

- 175g (6oz) butter, softened
- 175g (6oz) caster sugar
- 175g (6oz) self-raising flour
- 3 large eggs
- Zest of 2 lemons

For the drizzle:

- Juice of 2 lemons
- 100g (3.5oz) caster sugar

Instructions:

1. Preheat your oven to 180°C (350°F) and grease and line a loaf tin with parchment paper.
2. In a mixing bowl, cream together the softened butter and caster sugar until light and fluffy.
3. Gradually beat in the eggs, one at a time, adding a spoonful of flour with each egg

Message ChatGPT...
ChatGPT can make mistakes. Consider checking important information.

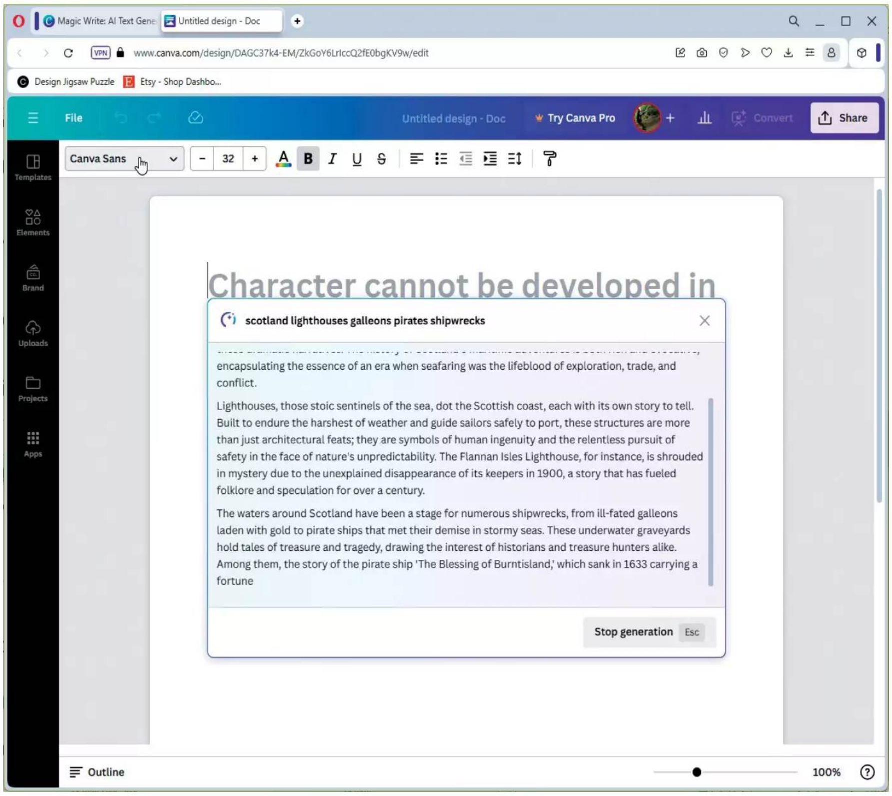
» **By using AI to search the web, you can get straight answers rather than pages of search results.**

© CHATGPT

6 MINE AND SUMMARIZE ONLINE CONTENT

As well as processing supplied text, ChatGPT and other AI engines can help you find live information on the internet. I asked Phind, "What was discussed on the latest edition of the *PC Pro* podcast?", and received an instant reply based on the published episode summary, even though the episode had only gone live that day. Similarly, I asked Microsoft Copilot, "What have I missed in the month of *This American Life* on WBEZ?", and received single-line summaries for each episode, along with a link to the relevant episodes online.

» If you've lost interest in a book, you can also use AI to save yourself the chore of reading what remains—



Character cannot be developed in

scotland lighthouses galleons pirates shipwrecks

encapsulating the essence of an era when seafaring was the lifeblood of exploration, trade, and conflict.

Lighthouses, those stoic sentinels of the sea, dot the Scottish coast, each with its own story to tell. Built to endure the harshest of weather and guide sailors safely to port, these structures are more than just architectural feats; they are symbols of human ingenuity and the relentless pursuit of safety in the face of nature's unpredictability. The Flannan Isles Lighthouse, for instance, is shrouded in mystery due to the unexplained disappearance of its keepers in 1900, a story that has fueled folklore and speculation for over a century.

The waters around Scotland have been a stage for numerous shipwrecks, from ill-fated galleons laden with gold to pirate ships that met their demise in stormy seas. These underwater graveyards hold tales of treasure and tragedy, drawing the interest of historians and treasure hunters alike. Among them, the story of the pirate ship 'The Blessing of Burntisland,' which sank in 1633 carrying a fortune

» **We gave Magic Write a few keywords, and it produced 255 words in seconds.**

assuming the text is available for it. I tried asking ChatGPT for a 100-word summary of the last chapter of *Great Expectations*. Its response not only outlined the key events, but gave them context, noting that the novel "concludes with a sense of closure as Pip reflects on his journey, finding contentment and acceptance in his newfound humility and the simple joys of life, leaving behind his great expectations".

7 COMMUNICATE ACROSS THE LANGUAGE BARRIER

As well as producing new text for native readers, ChatGPT can help you reach an international audience, with the ability to translate supplied text into a huge range of languages. That may not sound very new—Google Translate has been doing the same thing for years—but ChatGPT lets you apply more nuance to your translations. For example, you can ask it to use a friendly tone that's suitable for children, or write more formally for professional communications.

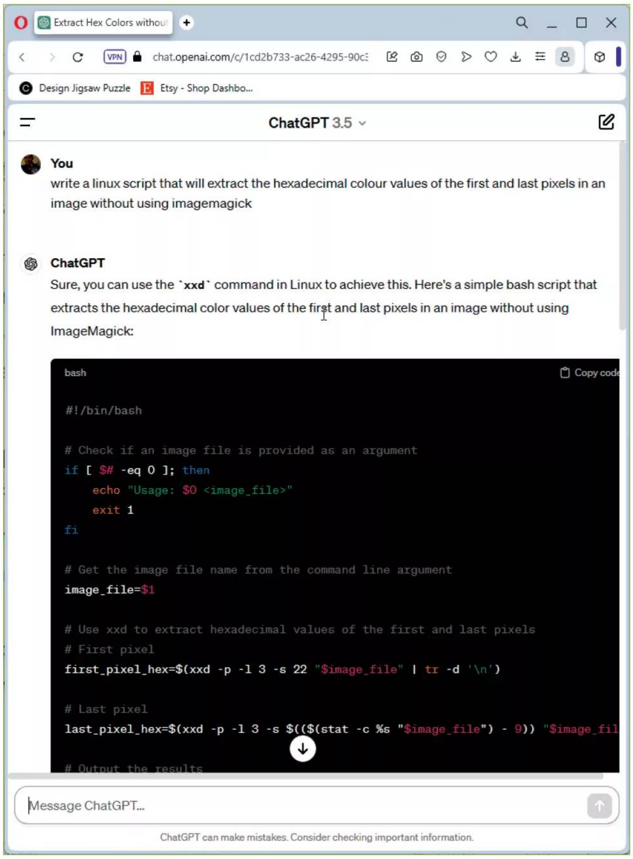
» ChatGPT also benefits from its ability to remember input across multiple exchanges. This makes it very quick and easy to produce multiple translations of a passage. Just enter 'translate the following text into French', then follow up with 'now translate it into German', 'now Spanish', and so on. Officiallly, the service supports more than 80 languages, though it might not be as fluent in some of them as others—as always with translation, it's best to run your output past a native speaker before publishing it to the world.

8 BRUSH UP YOUR OWN LANGUAGE SKILLS

As well as translating text into other languages, ChatGPT's conversation-style interface makes it a powerful tool for improving your own fluency. Gliglish (gliglish.com) is an online chat system that allows you to have interactive, AI-powered conversations, or role-play scenarios in more than 30 languages. You can use it without charge for 10 minutes every day, with conversations capped at 50 messages, or upgrade to a paid plan at $29 a month, or $299 annually.

» While Gliglish focuses on spoken-word interactions, Talkpal (talkpal.ai) uses GPT to provide a classic text-entry environment with a focus on conversation. Established language brand Berlitz (berlitz.com) has also moved beyond the tapes and records that made its name, and partnered with Microsoft, using Azure AI Speech to deliver new content to learners and gauge the accuracy of users' own speech through pronunciation assessment.

» The popular Duolingo platform (duolingo.com) has likewise recently started using GPT-4.0 to power its new Duolingo Max subscription service. This includes an 'Explain my answer' feature, which drops you into an interactive chat session where you can discuss your responses and explore the points of language. There's also a new dynamic role-playing feature, which lets you hold free-flowing, open-ended



You

write a linux script that will extract the hexadecimal colour values of the first and last pixels in an image without using imagemagick

ChatGPT

Sure, you can use the `xxd` command in Linux to achieve this. Here's a simple bash script that extracts the hexadecimal color values of the first and last pixels in an image without using ImageMagick:

```bash
#!/bin/bash

# Check if an image file is provided as an argument
if [ $# -eq 0 ]; then
    echo "Usage: $0 <image_file>"
    exit 1
fi

# Get the image file name from the command line argument
image_file=$1

# Use xxd to extract hexadecimal values of the first and last pixels
# First pixel
first_pixel_hex=$(xxd -p -l 3 -s 22 "$image_file" | tr -d '\n')

# Last pixel
last_pixel_hex=$(xxd -p -l 3 -s $(($(stat -c %s "$image_file") - 9)) "$image_fil

# Output the results
```

ChatGPT can make mistakes. Consider checking important information.

» **Need help coding a function or script? AI is often the quickest route to an answer.**

© CANVA

conversations with the characters that live inside Duolingo. For now, this is only available to English speakers learning Spanish or French on an iOS device, but there are plans to extend coverage to other languages and platforms.

9 DISCOVER HOME ENTERTAINMENT

Too many streaming services and not enough time? Microsoft Copilot can help you pick what to watch by combining the power of ChatGPT with the latest online data. I asked it to "recommend the best shows of 30 minutes or less on Netflix and Apple TV+". It suggested *Grace and Frankie* on Netflix, and *Shrinking* and *Mythic Quest* on Apple TV+. "Are these all available to US subscribers?" I then asked, to which it replied, "yes, all the mentioned shows are available to US subscribers. Enjoy your binge-watching!"

» These aren't particularly bad recommendations; they're popular shows that mostly fit within the requested time limit, although some episodes can run longer. You can refine your search by asking for specific types of show, themes, or actors to help coax out results that are more specific to your tastes.

10 PLAN A TRIP

ChatGPT can't directly read maps, but it has absorbed enough content to be able to provide extensive advice on journeys and destinations. For example, I asked it to "suggest a free day out in Pennsylvania, less than an hour's drive from Philadelphia, which would be suitable for a family of two adults and two children aged five and seven". It came back with two options, including extensive details of sites to visit with historical context and specific suggestions for children's activities.

» The AI can also put together an itinerary, for either a single day or a whole holiday. While it can't yet provide turn-by-turn directions, add-on tools can generate maps of waypoints and attractions to assist with travel plans. One good example is ForgeMyTrip (forgemytrip.com), which is $5.99 per month for unlimited usage.

AI TODAY & AI TO COME

AI can do remarkable things, but it's not always bang on in its answers. Most services will openly acknowledge this, and warn that you should check your AI-generated answers before relying on them.

However, the speed at which the technology is improving is remarkable. Nobody yet knows where AI will ultimately take us, but it's only going to get more powerful—and this will probably result in fundamental changes in the ways we live and work. Speaking on CBS last year, Google CEO Sundar Pichai called AI "the most profound technology humanity is working on. More profound than fire, electricity, or anything that we have done in the past." You can start harnessing its power today.

Join the conversation!

Discuss all things PC gaming with fellow readers at our official forums
forums.pcgamer.com

PC GAMER

Fix problems with Windows Repair

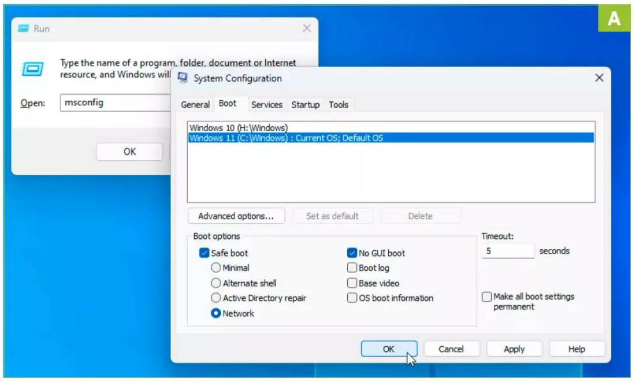
YOU'LL NEED THIS

TWEAKING.COM'S WINDOWS REPAIR
(www.tweaking.com)
This comes in Free and Pro versions: we're focusing on the free version in this tutorial

IT DOESN'T MATTER how carefully you look after your Windows installation; things can—and do—go wrong. Whether it's a flaky installer introducing gremlins into your system or you're trying to recover from a malware infection, many fixes often involve complicated trips into the Registry, where the wrong tweak could risk even greater damage being done.

Thankfully, there are tools that specialize in such fixes. The best by far is Tweaking.com's Windows Repair tool. It may no longer be updated as frequently as it once was, but it remains an invaluable part of any user's toolkit, whether you're running Windows 10 or 11. In this tutorial, we'll run through its free troubleshooting and fix-it tools, ranging from restoring file permissions and repairing key system components to reversing the damage done by malware.

We'll also reveal how to perform some of its Pro-only fixes for free using other tools, and point you toward repair and fix-it tools for adding to your troubleshooting armory, including one that specializes in fixing issues preventing Windows from loading successfully. **–NICK PEERS**



Type the name of a program, folder, document or Internet resource, and Windows will

Open: msconfig

Windows 10 (H:\Windows)
Windows 11 (C:\Windows) : Current OS; Default OS

Boot options
☑ Safe boot
○ Minimal
○ Alternate shell
○ Active Directory repair
● Network
☑ No GUI boot
☐ Boot log
☐ Base video
☐ OS boot information

Timeout: 5 seconds
☐ Make all boot settings permanent

1 OBTAIN AND LAUNCH WINDOWS REPAIR

Head over to www.tweaking.com and click the 'Download Free Version' to download the setup file for Windows Repair. Once downloaded, simply double-click the file and follow the installation instructions. When the installer finishes, we recommend unchecking both boxes before clicking Next, followed by Finish. The reasoning is simple: Windows Repair is best run in Safe mode.

» If you'd prefer to download a portable version—for use on other machines via a USB flash drive, for example—then you'll need to source it from a third-party downloads site, such as Downloadcrew (www.downloadcrew.com/article/31975/winrepair_portable). Download the zip file to your hard drive, then extract the contents to a suitable folder on your external drive.

» Once the program is installed, you could put it to one side until it's needed, but we recommend running it immediately to allow it to perform some key maintenance tasks that can spot—and repair—non-critical problems that might escalate if left untreated. Note, however, that this requires rebooting your PC in Safe mode—with networking enabled so you have Internet access if it's required.

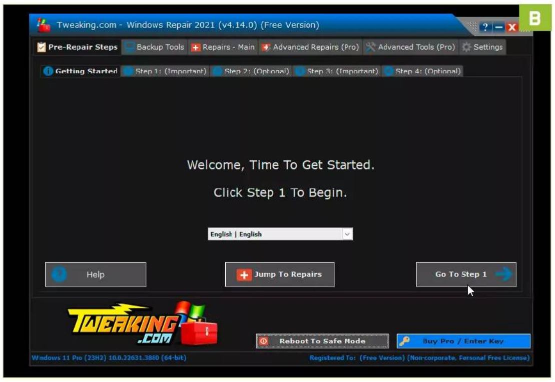
» You can do this via Settings, but it's a long, convoluted process that requires rebooting to the Advanced Startup Menu. A far simpler option is to press Win + R, type msconfig, and hit Enter to open the classic System Configuration tool. Switch to the Boot menu, select your target Windows installation (if applicable), then check Safe boot and select Network, as shown in [**Image A**] . Once done, click OK—you'll be prompted to restart, but you can ignore this for now (click 'Exit without restart') if you're not yet ready to reboot.

2 RUN INITIAL TEST

When you next reboot your PC, you'll find that it's now configured to boot directly into Safe mode (with networking support if your PC is connected to your network via an Ethernet cable). After logging in, Edge will open to Microsoft's support portal. Close the window and instead type 'repair' into the Start menu's Search box, clicking the 'Tweaking.com—Windows Repair' link to open the Windows Repair tool. If you're running the portable version of Windows Repair, open the Tweaking.com—Windows Repair folder, and double-click Repair_Windows.exe to launch it.

» The program requires administrative access, so click Yes at the UAC dialog. After a quick start-up check is performed, you may be prompted to update the program to the latest version should it receive another update (as of now, version 4.14.0 has been the latest version since June 2023). Click 'I Agree' if the EULA appears to access the program's main user interface, as shown in [**Image B**] .

» Windows Repair opens to the Pre-Repair Steps



Welcome, Time To Get Started.

Click Step 1 To Begin.

English | English

Windows 11 Pro (23H2) 10.0.22631.3880 (64-bit)

Registered To: (Free Version) (Non-corporate, Personal Free License)

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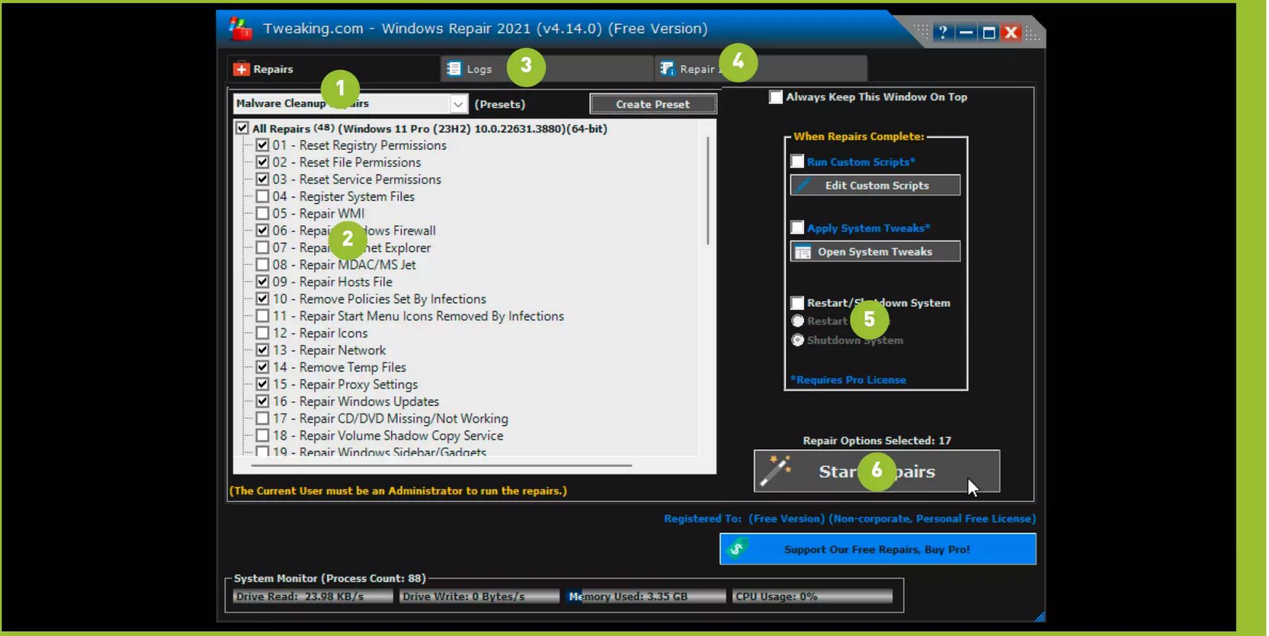
REPAIRS BREAKDOWN


Tweaking.com - Windows Repair 2021 (v4.14.0) (Free Version)
Repairs
Logs
Repair
1
2
3
4
5
6
Create Preset
Edit Custom Scripts
Open System Tweaks
Star pairs
Support Our Free Repairs, Buy Pro!

Malware Cleanup airs (Presets)

☑ All Repairs (48) (Windows 11 Pro (23H2) 10.0.22631.3880)(64-bit)
- ☑ 01 - Reset Registry Permissions
- ☑ 02 - Reset File Permissions
- ☑ 03 - Reset Service Permissions
- ☐ 04 - Register System Files
- ☐ 05 - Repair WMI
- ☑ 06 - Repai ows Firewall
- ☐ 07 - Repai net Explorer
- ☐ 08 - Repair MDAC/MS Jet
- ☑ 09 - Repair Hosts File
- ☑ 10 - Remove Policies Set By Infections
- ☐ 11 - Repair Start Menu Icons Removed By Infections
- ☐ 12 - Repair Icons
- ☑ 13 - Repair Network
- ☑ 14 - Remove Temp Files
- ☑ 15 - Repair Proxy Settings
- ☑ 16 - Repair Windows Updates
- ☐ 17 - Repair CD/DVD Missing/Not Working
- ☐ 18 - Repair Volume Shadow Copy Service
- ☐ 19 - Repair Windows Sidebar/Gadgets

(The Current User must be an Administrator to run the repairs.)

☐ Always Keep This Window On Top

When Repairs Complete:
- ☐ Run Custom Scripts*
- ☐ Apply System Tweaks*
- ☐ Restart/Sh down System
  - ● Restart
  - ○ Shutdown System

*Requires Pro License

Repair Options Selected: 17

Registered To: (Free Version) (Non-corporate, Personal Free License)

System Monitor (Process Count: 88)
Drive Read: 23.98 KB/s | Drive Write: 0 Bytes/s | Memory Used: 3.35 GB | CPU Usage: 0%

1. PRESETS
Windows Repair provides quick and easy ways to select multiple repairs depending on the type of fix you're looking for, from targeted (malware cleanup) to broad (common). Switch presets from this dropdown menu.

2. REPAIR LIST
A list of available repairs—most entries are a series of Registry fixes for known problems. Use the checkboxes to select and de-select entries, or 'All Repairs…' to select all or clear the selection.

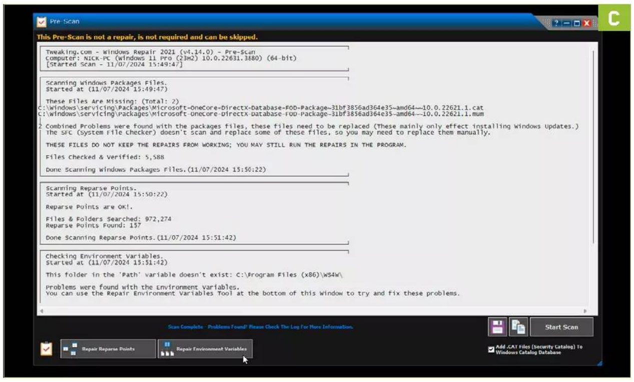
3. LOGS
After clicking the Start Repairs option, the view will then shift to this tab, where you'll see a progress report detailing the repairs as they're performed and whether they're successful (or not).

4. REPAIR INFO
Switch to this tab, then select your target repair from the drop-down menu that appears. Here, you'll see a description of what it does and what it attempts to fix.

5. RESTART/SHUTDOWN
Most repairs require you to reboot your PC—you can instruct Windows Repair to do this automatically once the repairs are complete. Remember: when you do this, you'll boot back into Safe mode.

6. START REPAIRS
Once you've made your selection, clicking this button will launch the repair process—there's no going back at this point, so proceed with caution!

tab—while it's tempting to jump to the repairs (particularly given the prominence of the button), if you've not run the program recently, we strongly suggest running through these steps first. They'll perform various Windows diagnostics that—in many circumstances—can fix the problem you're having without requiring further action. Click 'Go to Step 1' to get started.



This Pre-Scan is not a repair, is not required and can be skipped.

```
Tweaking.com - Windows Repair 2021 (v4.14.0) - Pre-Scan
Computer: NICK-PC (Windows 11 Pro (23H2) 10.0.22631.3880) (64-bit)
[Started Scan - 11/07/2024 15:49:47]

Scanning Windows Packages Files.
Started at (11/07/2024 15:49:47)

These Files Are Missing: (Total: 2)
C:\Windows\servicing\Packages\Microsoft-OneCore-DirectX-Database-FOD-Package~31bf3856ad364e35~amd64~~10.0.22621.1.cat
C:\Windows\servicing\Packages\Microsoft-OneCore-DirectX-Database-FOD-Package~31bf3856ad364e35~amd64~~10.0.22621.1.mum

2 Combined Problems were found with the packages files, these files need to be replaced (These mainly only effect installing Windows Updates.)
 The SFC (System File Checker) doesn't scan and replace some of these files, so you may need to replace them manually.

THESE FILES DO NOT KEEP THE REPAIRS FROM WORKING; YOU MAY STILL RUN THE REPAIRS IN THE PROGRAM.

Files Checked & Verified: 5,588

Done Scanning Windows Packages Files.(11/07/2024 15:50:22)

Scanning Reparse Points.
Started at (11/07/2024 15:50:22)

Reparse Points are OK!.

Files & Folders Searched: 972,274
Reparse Points Found: 157

Done Scanning Reparse Points.(11/07/2024 15:51:42)

Checking Environment Variables.
Started at (11/07/2024 15:51:42)

This folder in the 'Path' variable doesn't exist: C:\Program Files (x86)\WS4W\

Problems were found with the Environment Variables.
You can use the Repair Environment Variables Tool at the bottom of this window to try and fix these problems.
```

Scan Complete - Problems Found! Please Check The Log For More Information.

☑ Add .CAT Files (Security Catalog) To Windows Catalog Database

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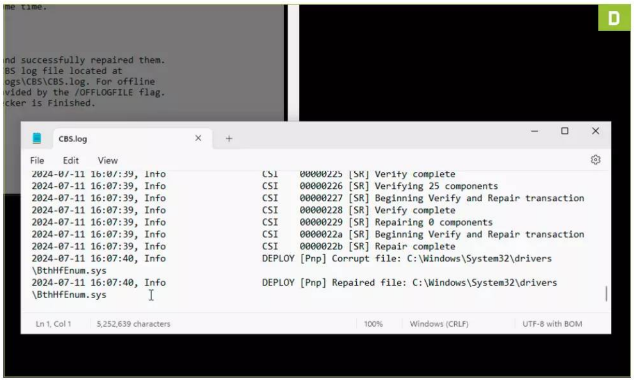
3 PERFORM PRE-REPAIR STEPS

The first step demands you do a 'proper power reset'. This involves draining all the electricity from your PC, which the tool says can resolve memory leaks, lack of system resources, and any other problems that might prevent the repairs from working. Click the Help button to view full instructions for doing this.

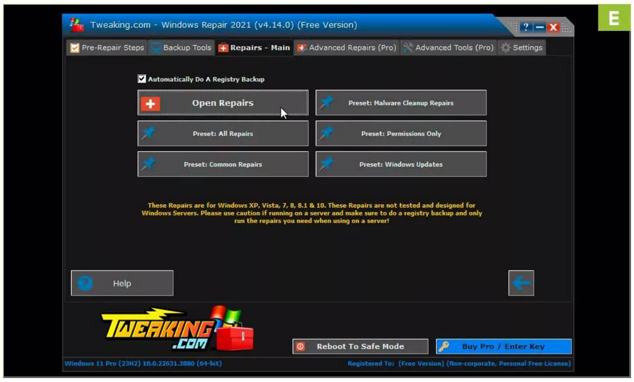
» Once complete, switch your PC back on—it'll boot back into Safe mode. Re-open Windows Repair and return to this screen, then click the right arrow button to move on to the second step, the 'optional' pre-scan. It may not be seen as mandatory, but we strongly recommend you click the 'Open Pre-Scan' button to switch to a new window, which describes the three tests that are performed. The first looks for missing Windows Packages from your system—if any are found, they may prevent other updates from being installed. It includes packages not scanned by the System File Checker (SFC) tool, but offers no repair tool—instead, you'll need to run DISM or obtain the packages manually—see the box for details.



```
me time.

nd successfully repaired them.
BS log file located at
ogs\CBS\CBS.log. For offline
vided by the /OFFLOGFILE flag.
cker is Finished.
```

```
2024-07-11 16:07:39, Info                  CSI    00000225 [SR] Verify complete
2024-07-11 16:07:39, Info                  CSI    00000226 [SR] Verifying 25 components
2024-07-11 16:07:39, Info                  CSI    00000227 [SR] Beginning Verify and Repair transaction
2024-07-11 16:07:39, Info                  CSI    00000228 [SR] Verify complete
2024-07-11 16:07:39, Info                  CSI    00000229 [SR] Repairing 0 components
2024-07-11 16:07:39, Info                  CSI    0000022a [SR] Beginning Verify and Repair transaction
2024-07-11 16:07:39, Info                  CSI    0000022b [SR] Repair complete
2024-07-11 16:07:40, Info                  DEPLOY [Pnp] Corrupt file: C:\Windows\System32\drivers
\BthHfEnum.sys
2024-07-11 16:07:40, Info                  DEPLOY [Pnp] Repaired file: C:\Windows\System32\drivers
\BthHfEnum.sys
```



☑ Automatically Do A Registry Backup

These Repairs are for Windows XP, Vista, 7, 8, 8.1 & 10. These Repairs are not tested and designed for Windows Servers. Please use caution if running on a server and make sure to do a registry backup and only run the repairs you need when using on a server!

Windows 11 Pro (23H2) 10.0.22631.3880 (64-bit)

Registered To: (Free Version) (Non-corporate, Personal Free License)

» The other two scans—covering reparse points and environment variables—come with repair tools. Click the 'Start Scan' button and wait for the tool to complete all three scans—if problems are found, try resizing the window [**Image C**] to make it easier to read. If you're prompted about reparse points or environment variables, click the relevant Repair button at the bottom of the window, then follow the prompts.

4 COMPLETE PRE-REPAIR SCANS

Once you've finished with the pre-scan, close the window and you'll be taken back to the main screen. Click the right arrow to move on to the disk-checking tool check. Click Check to perform a read-only scan to determine if problems exist that require fixing; if they do, click 'Open Check Disk At Next Boot' and restart your PC to perform the full disk check and repair.

» The next step is an optional System File Check—again, we recommend you run this test, so click Check to open a separate Command Prompt window, which will run the classic sfc / scannow. If any errors are found, you'll be prompted to reboot your PC to complete repairs. Before doing so, open C:\Windows\Logs\CBS\CBS.log, as shown in [**Image D**], to see what files have been repaired (Google the filename to find out more about it).

» Once rebooted, reload Windows Repair and switch to the Backup Tools tab where you'll see three backup options, two of which are available to free users. The Registry backup option is recommended, but note that it's automatically selected in the next step anyway, so you can skip it for now if you wish.

» We also recommend backing up file permissions. This is a Pro-only feature, but you can do this manually via the Command Prompt: press Win + R, type cmd and hit Enter to open it. Issue the following command to back up all the file permissions on your C drive to a single text file on the root of drive C (feel free to change this to point to your backup drive):

```
icacls C: /save "C:\permissions.txt" /t /c
```

» The process can take some time, so be patient—don't be surprised if some files can't be processed. The resulting file is likely to be somewhere between 500MB and 1GB, so plan accordingly. Should you need to restore your original file permissions, issue this command:

```
icacls C: /restore "C:\permissions.txt" /t /c
```

» The final option—to take a System Restore point—should be ignored. It shouldn't be needed to undo any repairs, and doesn't work in Safe mode. Clicking 'Create' will simply bring Windows Repair to a halt—even after closing it in Task Manager, the program won't run until you reboot back into Safe mode. If you want the additional security of a System Restore point, boot back into Windows before taking it and returning to Safe mode.

5 ACCESS REPAIRS

Time to switch to the Repairs—Main tab. You'll find six buttons, five of which offer preset options designed to fix specific problems. Ultimately, however, they're redundant—all they do is pre-select some or all of the 33 repairs offered by the program. As you can switch presets from the next screen, we suggest leaving 'Automatically do a Registry Backup' checked before clicking Open Repairs, as shown in [**Image E**] .

» You'll be presented with the main Repairs screen—for an overview, check the annotation opposite. It's all straightforward, and you'll see there are 46+ repairs in total that can be selected—or more accurately, 33 types of repair, with 12 file-association sub-repairs and options to repair the Recycle Bin on a drive-by-drive basis.

REPLACE WINDOWS PACKAGE FILES

Windows Repair offers built-in tools to fix system reparse point and environment variable problems, but if you come across any package file errors, you're expected to fix these manually. The first step is Windows' DISM tool, which you can run from an elevated command prompt. Just type the following command and hit Enter:

```
DISM.exe /Online /Cleanup-image /
Restorehealth
```

In many cases, you'll probably find this uncovers a more up-to-date online version, which once downloaded, could result in the error vanishing from a follow-up scan in Windows Repair.

If it doesn't, make a note of the corrupt package, then try to obtain it manually. If the package comes with a KB number, you should be able to download it from the Microsoft Support site via the following syntax: http://support.microsoft.com/kb/1234567 where 1234567 is the package number. You can also download updates through the Microsoft catalog—visit https://catalog.update.microsoft.com and use its search tool. If neither option works, try a simple Google search for the package name (or if you draw a blank, certain keywords such as 'microsoft onecore directx database fod').

It's worth noting that not all errors found here are necessarily problematic—if you can run a SFC ('sfc /scannow') check with no errors, then its likely issue isn't going to affect your Windows installation and can—for now at least—be safely ignored.

© TWEAKING.COM

» Switching to the Repair Info tab lets you run through each repair. We recommend doing this to see what will happen (and in some cases—for example, the Repair Hosts File—to see what backups are taken in case you need to change it back again). The descriptions don't go into a lot of detail, but should hopefully be sufficient to help you determine if the repair might help.

6 REPAIR YOUR SYSTEM

Once you've made your selection, click 'Start Repairs', and let Windows Repair run through the full set of repairs, monitoring its progress via the Logs tab. Once complete, you'll be prompted to restart if you haven't configured Windows Repair to do this automatically. Once you've rebooted back into Safe mode, reopen Windows Repair to the repairs window, make sure the same repairs are still selected, then click 'Start Repairs' to run through the repairs again. This ensures that if certain repairs couldn't be completed due to the status of other repairs, they should now be able to complete successfully.

» This time, when prompted to restart, click No. Instead, press Win + R, type msconfig, and press Enter again. Return to the Boot tab, Uncheck 'Safe boot', and click OK, followed by Restart to boot back into Windows proper, where your system should now be running correctly. It's not uncommon for your PC to feel a little sluggish after the repairs have finished—wait a short while, and reboot to see if your system speeds up. Be prepared to pause and reboot two or three times before the background processes finish the repair job and your system is back to normal.

» Should you find the repair hasn't taken, then check the box for details of other repair tools to try. If you feel you need to roll back the repairs, then reboot back into Safe mode, switch to the Backup Tools tab and click Restore under Registry Backup, switch to the Restore Registry tab and select your most recent backup from the drop-down menu. Finally, click 'Restore Now'.

7 ACCESS MORE REPAIRS

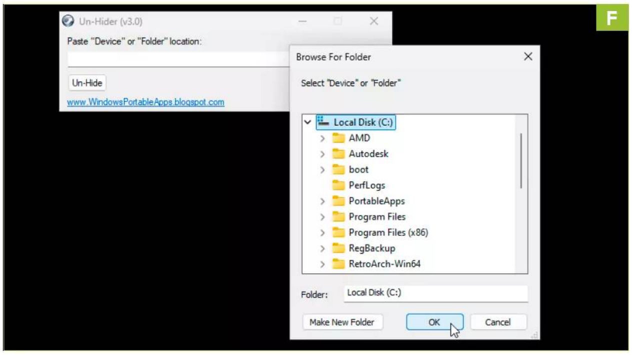
Windows Repair offers a paid-for tier that unlocks access to additional tools. This is not a one-time purchase, but an annual subscription (currently $24.95 a year for one PC, or $44.95 a year for three PCs). That's a bit rich, given the program hasn't been updated in over 12 months. However, many of its advanced repairs can be performed for free.

» Take the Advanced Repairs (Pro) tab. This lists four additional repairs. Windows Firewall Cleanup scans Windows Firewall for invalid rules. Most of these refer to programs you've removed from your computer—you can scan for and delete rules relating to non-existent .exe programs using a windows-firewall-cleanup tool from https://github.com/PoKeRGT/windows-firewall-cleanup—just double-click the downloaded FirewallCleanup.exe program and it'll run in a command prompt window.

» Windows Repair's Unhide Hidden Files tool is designed to undo the effect of certain malware that basically hides every file on your system. Doing this by hand is excruciating, but there's a free alternative in the form of Un-Hider 3.0, which can do all the hard work for you. Download it from its official mirror (www.majorgeeks.com/files/details/un_hider.html) and extract it using a tool capable of unpacking RAR files, like 7-Zip (www.7-zip.org). Double-click the exe file and click Device to select your hard drive [**Image F**] . Click OK, followed by Un-Hide. Repeat for any other drives.

» The 'Missing Package Files—Reg Cleanup tool' has no obvious alternative—most tools focus on cleaning the packages folder rather than detecting and removing orphaned Registry entries. Try posting on www.sysnative.com/forums/forums/windows-update.88 for personalized help.

» The final automated repair, 'Restore Default Printer Ports', can be achieved when in normal Windows mode: open Settings and choose Bluetooth & Devices > Printers & scanners, then click your printer and select 'Printer properties'. Switch to the Ports tab where you should be able to select the correct port for the printer before clicking OK to restore the connection. ⏻


Un-Hider (v3.0)
Paste "Device" or "Folder" location:
Un-Hide
www.WindowsPortableApps.blogspot.com
Browse For Folder
Select "Device" or "Folder"
Local Disk (C:)
AMD
Autodesk
boot
PerfLogs
PortableApps
Program Files
Program Files (x86)
RegBackup
RetroArch-Win64
Make New Folder
OK
Cancel

Folder: Local Disk (C:)

F

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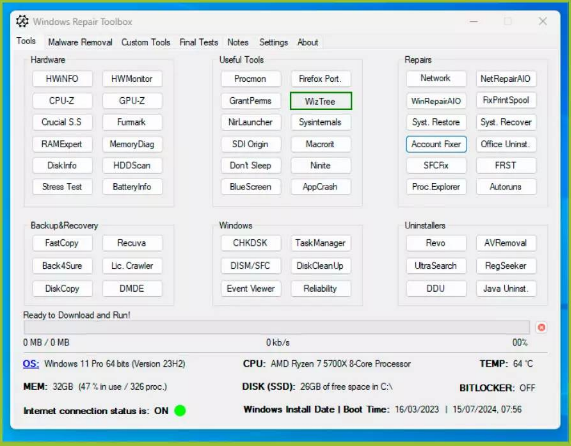
FIND MORE REPAIR TOOLS


Windows Repair Toolbox
Tools
Malware Removal
Custom Tools
Final Tests
Notes
Settings
About
Hardware
HWiNFO
HWMonitor
CPU-Z
GPU-Z
Crucial S.S
Furmark
RAMExpert
MemoryDiag
DiskInfo
HDDScan
Stress Test
BatteryInfo
Useful Tools
Procmon
Firefox Port.
GrantPerms
WizTree
NirLauncher
Sysinternals
SDI Origin
Macrorit
Don't Sleep
Ninite
BlueScreen
AppCrash
Repairs
Network
NetRepairAIO
WinRepairAIO
FixPrintSpool
Syst. Restore
Syst. Recover
Account Fixer
Office Uninst.
SFCFix
FRST
Proc.Explorer
Autoruns
Backup&Recovery
FastCopy
Recuva
Back4Sure
Lic. Crawler
DiskCopy
DMDE
Windows
CHKDSK
TaskManager
DISM/SFC
DiskCleanUp
Event Viewer
Reliability
Uninstallers
Revo
AVRemoval
UltraSearch
RegSeeker
DDU
Java Uninst.

Ready to Download and Run!

0 MB / 0 MB 0 kb/s 00%

OS: Windows 11 Pro 64 bits (Version 23H2) **CPU:** AMD Ryzen 7 5700X 8-Core Processor **TEMP:** 64 °C

MEM: 32GB (47 % in use / 326 proc.) **DISK (SSD):** 26GB of free space in C:\ **BITLOCKER:** OFF

Internet connection status is: ON **Windows Install Date | Boot Time:** 16/03/2023 | 15/07/2024, 07:56

Windows Repair offers fixes for many problems, but it's not the only tool you need in your armory. Start with recovery media—something you can boot into should the worst happen and Windows refuses to boot. Check out our last issue's guide to building the ultimate rescue disc, or at the very least, create a Lazesoft Recovery Suite disc (www.lazesoft.com) to give you access to a wide range of repairs for problems that prevent Windows from booting.

Windows Repair Toolbox (https://windows-repair-toolbox.com) is a portable tool that serves as a front-end to other repair and maintenance tools. It opens to its Tools tab, where you'll find a range of tools under various headings: click one and it'll either open or be downloaded and added to the program. You'll see a Repairs section covers your network, printer, user accounts and startup items. There are also links to several uninstallers as well as built-in Windows tools like Event Viewer.

Also take the time to explore the toolbox's other tabs: Malware Removal provides access to a range of malware cleaners, and you'll also find a Final Tests tab for seeing if the fixes applied have worked across a range of issues.

Securely delete Windows files

YOU'LL NEED THIS

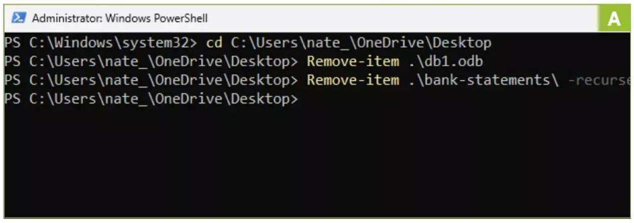
WINDOWS 11
An up-to-date installation
ERASER
GPARTED ISO

READERS WHO FOLLOWED OUR TUTORIAL on recovering deleted files using PhotoRec and TestDisk (August 2024, page 68) will know that they can be easy to recover.

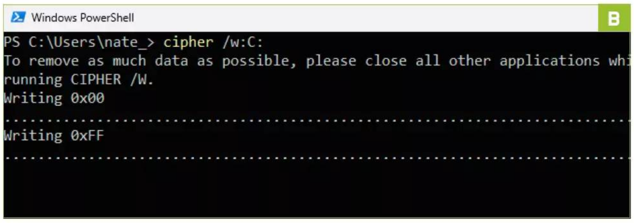
The one exception is devices using an SSD with TRIM enabled. In this case, when data is deleted, it's overwritten immediately, so is almost impossible to recover.

If this isn't true for your device, it's possible that your sensitive personal files could be salvaged even after you empty the Recycle Bin. This has huge privacy implications if your machine falls into the wrong hands, or even if you just want to recycle your PC.

Fortunately, there are specialist tools that can help to wipe files from your device securely. In this guide, you'll learn how to use Windows' own built-in utilities to securely erase files and folders. You'll also discover how to use specialist third-party tools like Eraser and GParted to securely wipe free space on your drive, or erase the contents altogether. **–NATE DRAKE**



```
PS C:\Windows\system32> cd C:\Users\nate_\OneDrive\Desktop
PS C:\Users\nate_\OneDrive\Desktop> Remove-item .\db1.odb
PS C:\Users\nate_\OneDrive\Desktop> Remove-item .\bank-statements\ -recurse
PS C:\Users\nate_\OneDrive\Desktop>
```



```
PS C:\Users\nate_> cipher /w:C:
To remove as much data as possible, please close all other applications whi
running CIPHER /W.
Writing 0x00
..............................................................................
Writing 0xFF
..............................................................................
```

1 USE WINDOWS TOOLS

If you only need to securely erase a handful of files or folders, you can do so quickly and easily via Windows PowerShell.

» To get started, first type 'Powershell' into the Windows search bar. Right-click on 'Windows PowerShell', and choose 'Run as Administrator'.

» You can now use the 'CD' command to navigate to the folder containing the files you want to remove, eg:

```
CD C:\Users\nate_\OneDrive\Desktop
```

» Next, you can use the 'Remove-item' command to securely erase the file in question. For instance, to erase the database file db1.odb, run:

```
Remove-item db1.odb
```

» If you need to remove a folder then you can add the '-recurse' parameter—for example, to securely erase the folder 'bank-statements' and all its contents, run:

```
Remove-item bank-statements -recurse
```

[**Image A**]

» By default, this command cannot remove hidden or read-only files. If you find that you can't erase a file for this reason, then add the '-force' parameter. For example, to remove 'hidden-file.txt' from C:\Test, run:

```
Remove-Item -Path C:\Test\hidden-file.
txt -Force
```

» The above command also uses the '-Path' parameter to specify the file location. You can use this to provide the location of regular files and folders, too.

» If you need to wipe a large number of files of a particular type, use the '-Include' parameter, eg:

```
Remove-Item * -Include *.docx
```

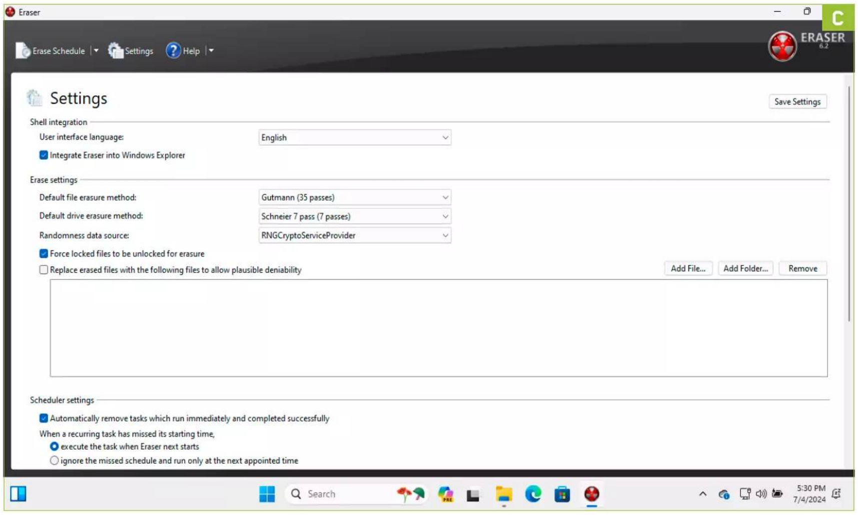
» If you've already deleted files by emptying the Recycle Bin, 'Remove-item' won't work, as there are no existing file paths.

» Fortunately, Windows has another built-in tool named cipher, which can overwrite free space on your drive. Cipher.exe is primarily designed for encrypting/decrypting NTFS drives, but more modern versions can also erase deleted data.

» Before getting started, make sure you save and close any open programs besides PowerShell itself.

» You can now specify a folder or entire drive to overwrite its free space, e.g.: [**Image B**]

```
cipher /w:C:
```



Settings

Shell integration
User interface language: English
☑ Integrate Eraser into Windows Explorer

Erase settings
Default file erasure method: Gutmann (35 passes)
Default drive erasure method: Schneier 7 pass (7 passes)
Randomness data source: RNGCryptoServiceProvider
☑ Force locked files to be unlocked for erasure
☐ Replace erased files with the following files to allow plausible deniability

Scheduler settings
☑ Automatically remove tasks which run immediately and completed successfully
When a recurring task has missed its starting time,
● execute the task when Eraser next starts
○ ignore the missed schedule and run only at the next appointed time

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2 USING ERASER

Though Windows' built-in commands offer a simple way to securely delete files and overwrite free space on a drive, grappling with the command line can be problematic. They also don't offer many configuration options.

» Fortunately, there are plenty of utilities with a friendly GUI that can securely delete data on Windows. Our tool of choice is Eraser.

» To get started, head to https://eraser.heidi.ie/download. We recommend choosing the 'Complete' install during setup.

» On first launch, click on 'Settings' to explore Eraser's configuration. As you'll see, the 'Default File Erasure Method' is Gutmann. This involves overwriting deleted files 35 times with random data. This makes recovery much harder, but will take longer relative to other options like a single pass of pseudorandom data.

» This single pass is Eraser's default method for wiping drives. You can also change this to a more secure method like the US DoD (Department of Defense) 5220.22-M. This involves three 'passes' of overwriting data: once with zeroes, once with ones, and finally with random data.

» If you want to strike a good balance between efficiency and secure erasure, we recommend the 'Schneier' method, which makes a total of seven passes: two of zeroes and ones, then five using random data. [**Image C**]

» To add files or folders for removal, select 'Erase Schedule' in the top left. Next, right-click anywhere in the window to launch a 'new task'.

» In the window that appears, choose 'Add Data', then 'Browse' to select any files to erase securely. Click one of the radio buttons next to 'Task Type' to schedule the job, eg. 'Run immediately.' [**Image D**]

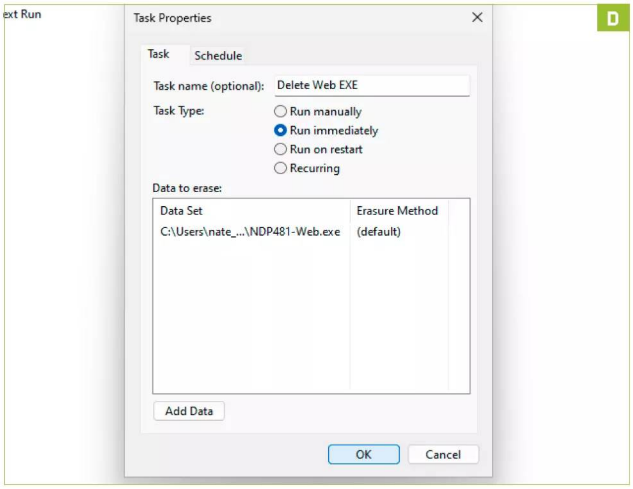
» Click 'OK' to continue. Eraser also supports overwriting free space on a drive for files that have already been deleted. To do this, create a 'New Task' and click 'Add Data' once again.

» In the 'Target Type' drop-down menu, choose 'Unused Disk Space', then select the relevant drive under 'Settings'. Click 'OK' once again to continue. [**Image E**]

3 WIPE YOUR SYSTEM DRIVE

While Eraser is an excellent utility for overwriting free space and securely deleting files, if you're selling or recycling your PC, you may want to wipe the entire hard disk.

» If your device has an SSD with TRIM enabled, it's usually safe just to reset your PC using the Recovery tools in Windows settings.

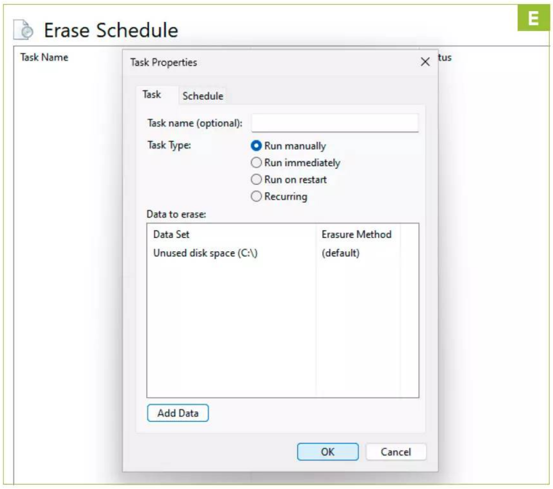


Task name (optional): Delete Web EXE

Task Type:
○ Run manually
● Run immediately
○ Run on restart
○ Recurring

Data to erase:

Data Set	Erasure Method
C:\Users\nate_...\NDP481-Web.exe	(default)



Task name (optional):

Task Type:
● Run manually
○ Run immediately
○ Run on restart
○ Recurring

Data to erase:

Data Set	Erasure Method
Unused disk space (C:\)	(default)

» If you want to play it safe, you can boot an alternative OS from a USB or DVD to securely wipe the system drive.

» To get started, head to https://gparted.org/download.php to download the ISO image for GNOME Partition Editor. You'll need to either burn this to a DVD or (more likely) use a tool like Rufus (https://rufus.ie) to make a bootable USB.

» You may also need to configure your device's BIOS/UEFI settings to allow booting from external disks.

» On first boot, enter '0' to load the graphical version of GParted. Once the desktop loads, your various drives and partitions will be listed. Scan through these to find the system partition—this is usually the one with the largest 'Size'. Once you've found it, make a note of the 'Partition', eg. /dev/sda3.

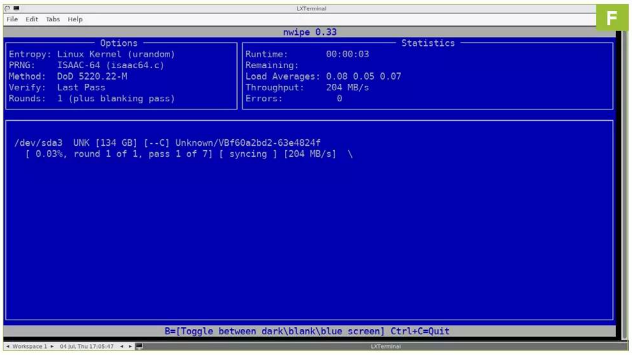
» Next, close the Partition Editor, then right-click anywhere on the desktop. Choose 'Terminals' > 'lxterminal with root privileges'.

» From here, you can use the 'nwipe' command to securely wipe the system partition on your hard disk. (As GParted loads into RAM it won't be affected by this). Enter the command, followed by the disk name, eg:

```
nwipe /dev/sda3
```

» Once the utility launches, you'll see that the default 'method' for erasing drives is the same three-pass method we saw in Eraser (US DoD 5220.22-M short wipe). If you want to change this, tap 'm' to choose an alternative, such as the DoD standard wipe, which uses seven passes. Use the arrow keys to move between these, then space to select.

» To start the wipe, tap the spacebar to select your drive, then hold Shift + S. [**Image F**] ⏻



```
                              nwipe 0.33
 ─────────── Options ───────────  ──────────────── Statistics ────────────────
 Entropy: Linux Kernel (urandom)   Runtime:        00:00:03
 PRNG:    ISAAC-64 (isaac64.c)     Remaining:
 Method:  DoD 5220.22-M            Load Averages: 0.08 0.05 0.07
 Verify:  Last Pass                Throughput:    204 MB/s
 Rounds:  1 (plus blanking pass)   Errors:          0

  /dev/sda3  UNK [134 GB] [--C] Unknown/VBf60a2bd2-63e4824f
    [ 0.03%, round 1 of 1, pass 1 of 7] [ syncing ] [204 MB/s]  \

              B=[Toggle between dark\blank\blue screen] Ctrl+C=Quit
```

Secure your DNS settings

YOU'LL NEED THIS

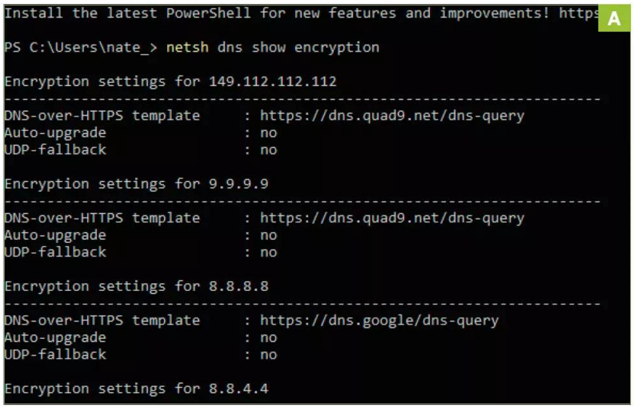
WINDOWS 11
An up to date installation
VPN Subscription (Optional)

THE ORIGINAL DOMAIN NAME SYSTEM (DNS) specifications were published by the Internet Engineering Task Force in 1983. This was a more innocent time, when most internet users were government employees and academics.

As such, there was no provision for encrypting DNS queries. By default, they're simply sent in plaintext over UDP. Anyone monitoring a user's connection, such as an ISP, can see every site they visit.

This lack of security and authentication also means that web users can be subjected to 'DNS Poisoning', whereby a device is sent the IP address for a malicious site, instead of one for a legitimate domain.

There are several competing standards for securing DNS queries. In this guide, we'll explore how to enable one of these (DoH) on Windows 11 and, if necessary, in your browser. You'll also learn how to boost your DNS security through using a VPN and the dark web. **–NATE DRAKE**



```
Install the latest PowerShell for new features and improvements! https

PS C:\Users\nate_> netsh dns show encryption

Encryption settings for 149.112.112.112
----------------------------------------------------------------------
DNS-over-HTTPS template     : https://dns.quad9.net/dns-query
Auto-upgrade               : no
UDP-fallback               : no

Encryption settings for 9.9.9.9
----------------------------------------------------------------------
DNS-over-HTTPS template     : https://dns.quad9.net/dns-query
Auto-upgrade               : no
UDP-fallback               : no

Encryption settings for 8.8.8.8
----------------------------------------------------------------------
DNS-over-HTTPS template     : https://dns.google/dns-query
Auto-upgrade               : no
UDP-fallback               : no

Encryption settings for 8.8.4.4
```

1 ENABLE DOH (DNS OVER HTTPS)

As we've learned, by default, all DNS requests are sent to the server unencrypted, meaning that anyone with access to your ISP's records can see what websites you've visited.

» Ordinarily, when you visit a secure website, for example, to do online banking, your connection is encrypted via TLS. However, if you're using regular DNS, in this case, an adversary would still know what online bank you've accessed, which could put your privacy at risk.

» DoH (DNS over HTTPS) is one solution to this dilemma. In the simplest terms, it uses HTTPS to establish a secure, encrypted connection to the DNS server. This means that your DNS requests are encrypted in the same way as secure website traffic over port 443.

» Not all DNS Providers support DoH. Windows 11 has a preconfigured list you can choose from.

» To get started, open Windows Terminal or PowerShell, and run:

```
netsh dns show encryption
```

» This will display a list of supported providers both for IPv4 and IPv6. [**Image A**] Make a note of the relevant IP address for your chosen DNS service, eg. Google's IPv4 addresses are 8.8.8.8 and 8.8.4.4. Be sure to make a note of the corresponding IPv6 addresses, too.

» Armed with this information, close Terminal/PowerShell and open Windows settings by holding the Windows key + i.

» In the 'Settings' pane, choose 'Network & Internet'. Next, click into your primary connection in the main pane, e.g. 'Ethernet'. Scroll down to 'DNS Server Assignment' and click 'Edit'.

» In the new 'Edit DNS Settings' window, select 'Automatic (DHCP)' to switch to 'Manual'. [**Image B**] Enable 'IPv4' and enter your chosen server into 'Preferred DNS', eg. 8.8.8.8. Set 'DNS over HTTPS' to 'On (automatic template)'. Enter the other IPv4 address, eg. 8.8.4.4 into the 'Alternate DNS' field, then enable DoH in the same way as for the primary server. [**Image C**]

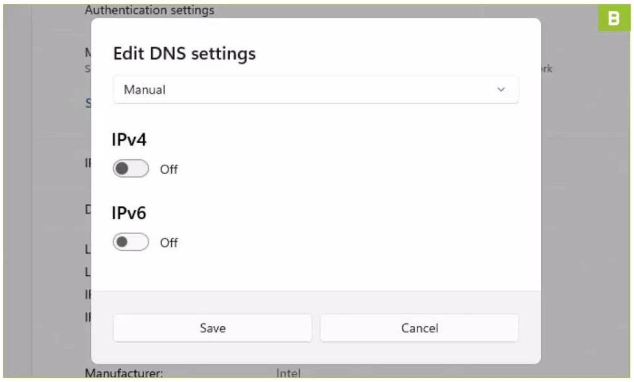
» Choose 'Save'. Next, enable the IPv6 switch, and repeat these steps using the IPv6 addresses you noted down earlier.

2 CHECK BROWSER SETTINGS

Once you've updated your Windows 11 DNS settings to use DoH, your 'Network and Internet' settings should list the server address and state that it's encrypted, eg. '8.8.4.4 (Encrypted).

» Next, double check your new settings are working correctly by launching your web browser. Head over to a specialized website like https://ipleak.net or www.dnsleaktest.com. We recommend the 'Extended Test'.

» Doing this will confirm that your DNS server now matches your chosen provider. Next, point your browser



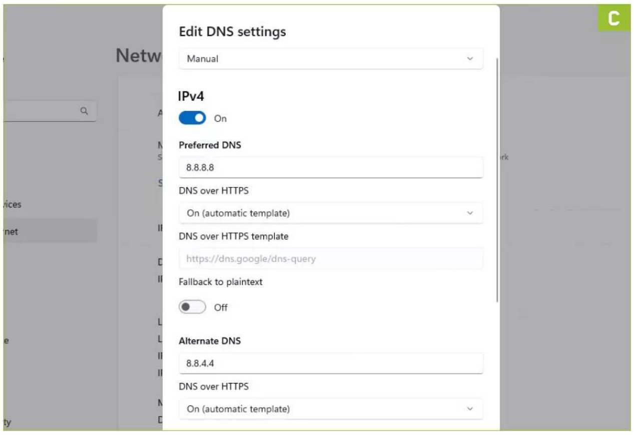
Edit DNS settings

Manual

IPv4
○ Off

IPv6
○ Off

© MICROSOFT


C

Edit DNS settings

Manual

IPv4

On

Preferred DNS

8.8.8.8

DNS over HTTPS

On (automatic template)

DNS over HTTPS template

https://dns.google/dns-query

Fallback to plaintext

Off

Alternate DNS

8.8.4.4

DNS over HTTPS

On (automatic template)

to https://1.1.1.1/help. Give the online tool a few moments to check your settings. If all goes well then 'Using DNS over HTTPS (DoH)' should read 'Yes'. Note: this tool will work even if you didn't configure Windows to use Cloudflare's DNS Servers.

» If 'DNS over HTTPS' reads 'No', first save and close any open programs or files, then restart your device. This will reload your network configuration.

» On reboot, check if Cloudflare's test tool still shows that DoH isn't enabled. If it still isn't working, the most likely reason is that your browser's own DNS settings is in conflict with those you configured for Windows.

» The simplest way to resolve this is to use the Microsoft Edge browser. During our tests for this tutorial, we found that it automatically updates its DNS configuration based on Windows 11 system settings.

» If you're using Chrome, click the … at the top right of the browser window, then choose 'Settings'. Select 'Privacy and security' from the left-hand pane, then click on 'Security' in the main window. Scroll down and check that 'Use Secure DNS' is enabled and 'Select DNS Provider' is set to 'OS Default'.

» If you're a Firefox user, select the three lines at the top right of the browser and window and click into 'Settings'. Next, choose 'Privacy & Security' from the left-hand pane, then scroll down to 'DNS Over HTTPS'. Make sure DoH is set to 'Off' to ensure Firefox defaults to Windows 11 settings. [**Image D**]

3

BOOST YOUR DNS PRIVACY

Security-minded readers may already have noticed the flaw in using DoH with the approved DNS providers in Windows 11. While DNS queries are encrypted in transit, the DNS server knows which sites your device is attempting to access.

» This means you have to trust the likes of Google to secure their DNS servers against hackers, as well as not to log DNS queries. You can gain some peace of mind by checking the provider's T&C's carefully—for instance, Cloudflare has a strict privacy policy, which claims never to log user data.

» If you want more assurances, consider subscribing to a reliable VPN service. When configured properly, all data between your device and the server is sent and received via an encrypted virtual tunnel. This includes DNS queries.

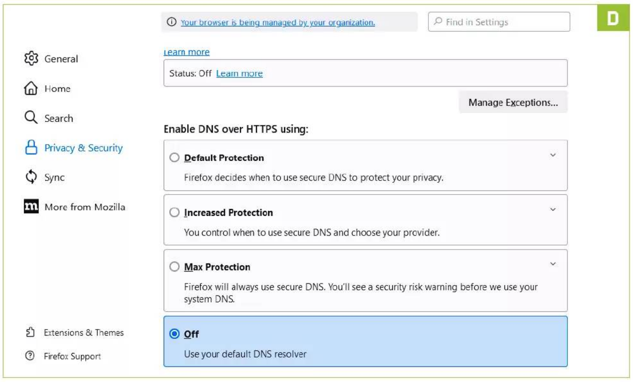
» Not all VPN providers do this. Believe it or not, some encrypt your web traffic while still leaving your DNS requests to be managed by your ISP. If you need help choosing a reliable provider, our sister site TechRadar maintains a list of the best ones (www.techradar.com/vpn/best-vpn).

» Be warned that many VPN services claim to adhere to a strict 'no logs' policy. Try to find a provider who regularly submits to independent security audits.

Once you've installed the VPN client software, ideally all DNS queries will be sent via the encrypted tunnel and resolved by the VPN server. You can double check this using the online testing tools mentioned in Step 2. Your DNS server should be listed as being in the same country as the VPN server, not your home state. [**Image E**]

» If you have no faith in VPN providers, consider installing the Tor Browser (www.torproject.org/download). Although the browser requires DNS to visit clearnet sites, no DNS queries are required for dark web (.onion) addresses.

» These addresses represent the identity public key of the relevant Onion service, to which Tor connects via a series of relays. No DNS lookup is required. [**Image F**]


D

Your browser is being managed by your organization.

Learn more

Status: Off Learn more

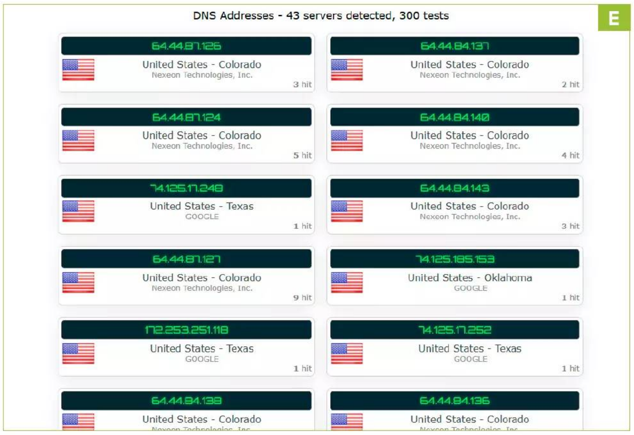
Enable DNS over HTTPS using:

○ **Default Protection**
Firefox decides when to use secure DNS to protect your privacy.

○ **Increased Protection**
You control when to use secure DNS and choose your provider.

○ **Max Protection**
Firefox will always use secure DNS. You'll see a security risk warning before we use your system DNS.

● **Off**
Use your default DNS resolver


E

DNS Addresses - 43 servers detected, 300 tests

64.44.87.126 United States - Colorado Nexeon Technologies, Inc. 3 hit	64.44.84.137 United States - Colorado Nexeon Technologies, Inc. 2 hit
64.44.87.124 United States - Colorado Nexeon Technologies, Inc. 5 hit	64.44.84.140 United States - Colorado Nexeon Technologies, Inc. 4 hit
74.125.17.248 United States - Texas GOOGLE 1 hit	64.44.84.143 United States - Colorado Nexeon Technologies, Inc. 3 hit
64.44.87.127 United States - Colorado Nexeon Technologies, Inc. 9 hit	74.125.185.153 United States - Oklahoma GOOGLE 1 hit
172.253.251.118 United States - Texas GOOGLE 1 hit	74.125.17.252 United States - Texas GOOGLE 1 hit
64.44.84.138 United States - Colorado	64.44.84.136 United States - Colorado

F

Arti 1.2.5 is released: onion services development, security fixes

by Diziet | June 27, 2024

Upcoming Events

July 12, 2024 – July 14, 2024
HOPE XV

July 15, 2024 – July 20, 2024
24th Privacy Enhancing Technologies Symposium (PETS)

Recent Updates

Arti 1.2.5 is released: onion services development, security fixes
by Diziet | June 27, 2024

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LAB NOTES

ZAK STOREY, CONTRIBUTOR

Variety is the spice of life

Market saturation is killing progress

I'VE WAXED LYRICAL about Geometric Future over the last few issues, but its take on chassis design has got me thinking about the PC marketplace as a whole. Let's consider handhelds for a moment. In 2021, out of nowhere, Valve announced its first-edition Steam Deck. This new, potent, powerful, and reasonably priced handheld finally gave PC enthusiasts the opportunity to play their gargantuan Steam libraries anywhere in the world—albeit for a short time, before the battery dies. It sold like hot cakes, and boy, did people notice.

Jump forward to today, and everyone is launching handheld gaming PCs left, right, and center; some good, some bad, some average, In fact, my colleague, Aleksha McLoughlin, published a fantastic article in *PC Gamer* about it. It's well worth a read.

That got me thinking about the wider market in general, in particular how it's too predictable: one manufacturer builds something phenomenal, then six months later, eight to nine established brands launch something pretty much identical, but with a slight 'brand' tweak. It's tedious and boring, designed to keep revenue upticks predictable. It's almost like those dystopian sci-fi novels where some far-off alien race delves into cloning, slowly tweaking and altering the clones, time after time, until they devolve into an ugly blob on the floor. There's no innovation, no life here.

Snapdragon
X
Elite
Snapdragon
X
Plus

Whether it's processor generation, PCIe 5.0 drives, or fishbowl cases, there are a lot of product announcements, but few launches.

What you're left with, at least in our industry, is a bevy of products that, on the surface, are pretty much identical. They don't change or challenge anything; just iterative successions of the same thing, over and over again, slightly improving each time. PCIe 5.0 drives, fishbowl PC cases, OLED monitors, gaming chairs—they're all excruciatingly similar. This homogenization of design means we've got a lot of products, but few actual launches, and little in the way of genuine innovation. That's perhaps why ARM is so exciting: because it's different.

We need more risk-takers, more go-getters, and more innovation. I'm starting to think it's that reason alone as to why Moore's Law died, and why we don't have cities on Mars or flying cars just yet.

JEREMY LAIRD

Contributor

I run both PC and Mac. Personally, I think you need both, but whatever the pros and cons, the detailed differences can be revealing.

One of the more obvious things that MacBooks with Apple silicon do well is sleep. I've been running a MacBook since about six months after the original M1 chip was launched, and not once have I experienced anything other than instant response from a sleep state, during which they use virtually no power.

Every PC laptop I've owned had an issue with sleeping. Some had battery drain. Even the best use more power when sleeping than MacBooks. Others have reliability issues, either being slow to wake or outright hanging.

The worst examples don't sleep properly at all, going into a highly stressed state—the thing is roasting hot when you fish it out of a bag. Inevitably, that toasts the battery.

So is the problem with laptop PCs hardware or software? It's probably a bit of both, but on the hardware side, the arrival of the Qualcomm Snapdragon X chip with its Apple-esque Arm architecture makes for an intriguing data point.

The early signs are that Snapdragon X laptops are better at sleeping. It's not clear if that's something all Snapdragon X systems do well, but so far, it seems like Arm chips sleep more soundly than x86 chips, whether they're in Macs or PCs.

© QUALCOMM/COLLAGE BY TOM'S HARDWARE

0-60 in 4.1 seconds and instant torque makes me a gurning idiot.

Editor's Pick: Polestar 2 Long Range Dual Motor

This month, we delve into the mysterious world of EVs

I'VE TAKEN THE PLUNGE and invested in an EV. Car guys roam around my family a dime a dozen. Mom's side is obsessed with classic American muscle, while my dad's side rigidly stick with '67 Volkswagen split-screens, Beetles, and an armada of European sports cars. I've bitten the bullet, likely much to their chagrin (although I know my Dad's going to geek out over the tech as much as I have). Here's the thing, though: I've had 3.2L V6 Audis, silly turbo-charged 2.0L Golfs, and everything in between, even a hilarious Fiat 500 and a Mini Cooper during my time driving, and yet I've still finally ditched the lot and gone for the big switch.

EV depreciation is insane, and although that's less than ideal for new car buyers or used-car jockeys like myself, it means that there's some good deals out there for some seriously high spec vehicles, if you find the right one. They're starting to approach the realm of being 'affordable' from a second-hand perspective, and honestly, that's one of the biggest hurdles the technology has still got to get over: that barrier to entry.

So what did I get? The Polestar 2, Long Range Dual Motor. I managed to grab one for around $32,540 on a pretty slick finance deal. It has all the tech I wanted, is the right model year (2022, registered in October 2021, so new enough for the heat pump, but not too new that it doesn't have adaptive headlights), and it drives like nothing I've ever driven before. It also had only 11,000 miles on the clock.

I had my reservations about it, of course. I've been following the progress of EVs since 2019—battery range, and charging were definitely major concerns, particularly for a used vehicle, but so far it's been a smooth ride. Generally speaking, the Polestar 2 isn't an efficient EV—you effectively trade range for style. I can get about 240 miles on a sunny day before needing to charge (it can theoretically do 320 on a full charge in good conditions with an average speed of 50mph, but you'll generally be using 100-15 percent charge, and then back up to 90 percent on long journeys. Any less, and you'll go into turtle mode on the horsepower front), but to be honest, that's plenty for me.

What about battery degradation? That is a concern, I admit, but looking at the tech and doing the research, it's less impactful than you might think. The Polestar 2 LR has a maximum capacity of 78 kWh, around 75 kWh of which is 'usable'. There's meant to be three to four percent capacity loss in the first couple of years of ownership, then it tends to peter off and stabilize over the following years, thanks to some smart battery-management tech. There are tools to check battery health via the OBD port, and I've seen reports of PS2s with over 80,000-90,000 miles on the clock in less than three years still having 93 percent health or so, which isn't too bad. Polestar also has an eight-year or 100,000-mile warranty on the battery, replacing it for free if it falls below 70 percent.

It's the tech that has me hooked: how it drives, how it 'starts', how you unlock it, the safety features, and how it's built around Android. I've never driven something that's so comfortable, yet so immediate when I need it to be. Initially, I was flipping back and forth between this and a 2019 2.5L Audi TTRS (one last fun gas car before I became an adult/dad, possibly). I'm so glad I went with the Polestar, at least for now. We'll see how it pans out. **–ZS**

$32,540, www.polestar.com

© POLESTAR

Reviewed…

74 Asus Vivobook S 15 Copilot

76 MSI MPG321URX

78 MSI Stealth 16 AI Studio A1V

80 OneXPlayer X1

82 Asus ROG Zephyrus G14 (2024)

84 Gigabyte Aorus FO32U2

87 NZXT H7 Flow

88 SteelSeries Arctis Nova 4 Wireless

89 32GB Lexar Thor OC DDR5

90 Once Human

92 OneDrive vs Google Drive

Asus Vivobook S 15 Copilot

ARM dominates, yet AI still half-baked

THIS MIGHT BE ONE of the most exciting notebooks we've ever taken a look at. There's something quite unique about it, and it's all to do with processing. Don't let the buzzwords and marketing hype get to you first; yes, it does have AI features baked in as standard, and a lot of those are unique software elements well worth talking about, but the key thing is what's hidden away under the hood: the Snapdragon X Elite ARM processor.

Yep, this is none other than Qualcomm's 4nm Snapdragon X Elite X1E-78-100 CPU (catchy name). It packs in 12 cores, 42 MB of cache, a 3.4 GHz clock speed, and an Adreno GPU producing 3.8 TFLOPs of processing power, along with a dedicated NPU (neural processing unit, for AI operations) generating 45 TOPS. And all of that with a TDP of just 45 watts. That has been paired with 16GB of non-expandable soldered DDR5 RAM running at 8,440 MT/s. 16GB is on the low end, for sure, especially as the chip is capable of housing up to 64GB total. But it's not dissimilar to Apple's M3 series chips.

It still has all the modern-day bells and whistles here too. There's support for WiFi 7, Bluetooth 5.4, and plenty of clout for graphical rendering as well. One downside is that it lacks support for PCIe 5.0, but that's about it. Pair that with a phenomenal 18-hour battery life, and it's an absolute beast of a unit.

Here's the thing: throw this through some benchmarks, and it quickly gets interesting. In GeekBench 6.2.1, the Snapdragon scored 2,444 points in single-core, and 9,008 in the multi-core tests. For comparison, Huawei's Matebook D 16, featuring an Intel Core i9-13900H, landed 2,605 points in single core, and 12,568 points in multi-core respectively. Clearly that's a win for Intel, albeit just 6.5 percent in single-core, and 39.5 percent in multi-core (although it packs in 66 percent more threads). However, the 13900H tops out at 115W of power draw, versus the Snapdragon's 45W. For efficiency, the difference is astronomical. Take that single core percentage, divide it to see performance per watt, and you're left with 54.3 for Snapdragon and 22.7 points per watt for Intel. Even AMD is nowhere near that efficiency. But we're not done, because this isn't a normal run; this Snapdragon is emulating Windows, and these benchmarks, as it does this.

In 2020, we covered the rise of ARM, and how impressive it's generational leaps are. With its CEO declaring that it's aiming for 50 percent of the Windows market by 2029, well if we're honest, it's looking like a serious possibility.

Outside of the beautiful chassis, the crisp 120 Hz 2,880x1,620 OLED display, and solid PCIe 4.0 1TB SSD however, the big selling point for the Vivobook S 15, comes in the form of its AI featureset. It has Copilot as standard (Microsoft's equivalent of ChatGPT), which does ok, although is limited to 20 queries a day if you don't login. Then there's Recall, which hunts for your files based on description (coming soon to a Windows update near you), Live Captions, which will caption and auto-translate any media you're watching (usually quite slowly, two minutes behind, and performs badly with different languages or accents), co-creator, which allows you to draw something in paint, and convert it into an AI image using text prompts to mixed success, and finally Automatic Super Resolution, which 'should' act in a similar manner to DLSS or FSR in-game, upscaling and improving frame rates as it does so, although there's no way of telling if it's on or not.

The promise is there, but the features themselves are still very much in early development, if there at all. It's very reminiscent of those early days of ray tracing. Of course, gaming on a laptop of this caliber with no dedicated GPU and a CPU that's emulating everything,is lackluster, and although that AI upscaling could be effective, it needs some graphical horsepower to back it up. It almost makes us wish Nvidia had managed to snap up ARM as planned. Nonetheless, this is a beautifully designed laptop, and an exciting look at the future of processing, all tied up in a glorious Asus bow.
–ZAK STOREY

BENCHMARKS

	Asus Vivobook S 15 Copilot	HP Spectre Foldable	Huawei MateBook D 16 2024 (EU Only)
Crossmark Aggregate (Index)	1,168	1,405	**1,938**
GeekBench 6.2.1 Single-Core/ Multi-Core (Index)	2,444 / 9,008	2,210 / 6,635	**2,605/12,568**
Blender (Index)	N/A	26.81/17.14/11.69	**70.22/40.94/28.38**
CrystalDiskMark 8 Read/Write (MB/s)	5,024/3,623	**6,739/4,524**	4,905/3,952
3D Mark Wildlife Extreme	6,091	DNC	**13,731**
Total War: Warhammer 3 Low @ Native Resolution (avg fps)	13.7	DNC	**33.9**
Borderlands 3 Ultra @ Native Resolution (avg fps)	3.3	DNC	**10.27**
Price (USD)	$1,270	$4,850	**$1,200**

All benchmarks performed with a clean install of Windows 11, with the latest updates, chipset and drivers installed. Best scores in bold. Games tested at device's native resolution. Borderlands 3 tested at Ultra, Total War: Warhammer 3 tested at Low. Prices correct at time of writing.

VERDICT
9
KICK ASS!

Asus Vivobook S 15 Copilot

+ SNAPKICK Exceptional efficiency; 18-hour battery life; Solid performance; Beautiful chassis and screen; Well-priced.

− SNAPCHAT Lackluster gaming performance; soldered 16GB DDR5; PCIe 4.0 only.

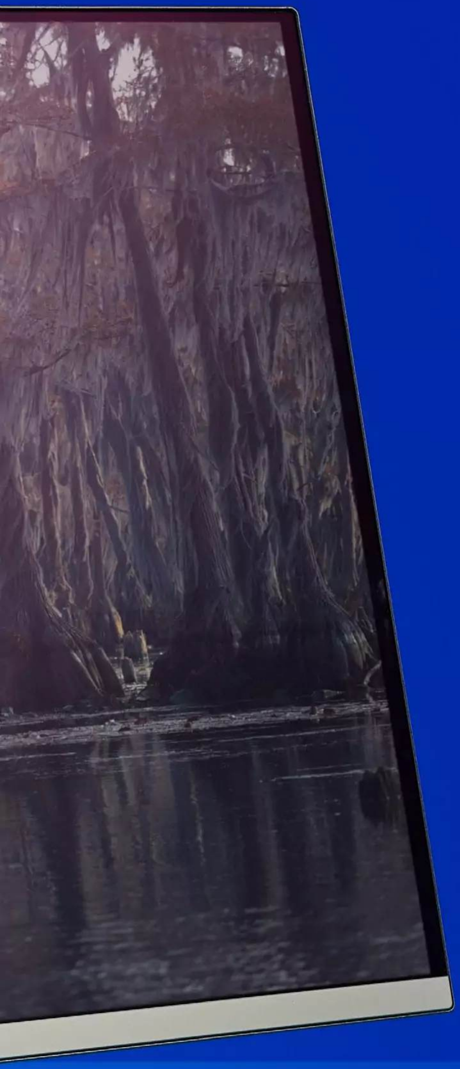
$1,270 www.asus.com

SPECIFICATIONS

CPU	Snapdragon X Elite X1E78100
GPU	Qualcomm Adreno 3.8
RAM	16GB LPDDR5-8440
Storage	1TB PCIe 4.0 M.2 SSD
Screen	15.6-inch 2,880x1,620, OLED, 600-nits, 120 Hz
Connectivity	2x USB Type-C Thunderbolt, WiFi 6E, Bluetooth 5.3
Dimensions	10.9 x 14.80 x 0.33 inches
Weight	3.57lbs

Sleek, slender, and beautiful, but packing some serious performance.

MSI's new 4K OLED is cheaper than the competition, if you can find it.


© UNSPLASH

MSI MPG321URX

The cheapest 4K OLED by far

AT LAST, we've got MSI's take on the new generation of 32-inch 4K OLED gaming monitors. Why have we been so keen to get our paws on the MSI MPG321URX? Simple: it's by far the cheapest. It's being offered for about $200 to $300 less than any other 32-inch 4K gaming OLED, so it's perhaps unsurprising that it sells out as soon as each new batch is released.

Still, you can't blame MSI. It offers the same Samsung-sourced QD-OLED panel as numerous other more expensive monitors, including the $1,300 Asus ROG Swift PG32UCDM and $1,200 Alienware AW3225QF. It's just a lot cheaper.

It also has the same basic specs, including 240Hz refresh, claimed 0.03ms response and 250 nits full-screen brightness, plus 99 percent DCI-P3 coverage and similar key benefits. That's OLED's perfect per-pixel lighting and huge speed advantage over any LCD panel, along with the 4K-enabled pixel density and image sharpness that was lacking from earlier OLED monitors.

What's more, the broader feature set doesn't suffer from the sharp pricing. Along with a pair of HDMI ports and a DisplayPort interface, there's USB-C with 90W of power delivery. That's something the more expensive Alienware lacks, while the Gigabyte's USB-C interface is limited to a fairly pointless 18W. Heck, you even get a KVM switch thrown in.

As to what you're *not* getting, the answer is not much. In terms of image quality, the most obvious highlights are contrast, clarity, and speed. Like every other QD-OLED 32-incher, the MSI MPG321URX runs a lovely glossy coating. It's a slightly contentious issue, but we're in the pro-glossy camp. It's essential to let an OLED panel strut its high-contrast HDR stuff, and this thing positively pops.

It's also fast both in response terms and latency, the latter thanks to 240Hz refresh, which is as good as it gets for 4K. The only thing it obviously lacks is the 480Hz pixel doubling 1080p mode of LG's upcoming 32-inch 4K OLED monitor, based on its own WOLED rather than Samsung QD-OLED tech.

To address the question of how this MSI model compares to those other QD-OLEDs, they all tend to run a little warm in terms of color temperature, and this MSI is no exception. It's probably a function of how QD-OLED works. The quantum dots don't only react to light from the OLED subpixels; they convert and kick back some of the ambient light. That's why black tones on QD-OLED panels can look gray in lots of ambient light. The quantum dots being activated by ambient light may be at least in part to blame for the perceived warmth of these monitors. We wouldn't class it as truly problematic; it's more something to be aware of.

Full-screen brightness performance is another critical area for OLED monitors. Subjectively, the MSI MPG321URX looks very much on par with other QD-OLEDs and good for the claimed 250 nits. For the record, MSI provides the same three-year burn-in warranty cover as other brands.

As for niggles, there is no ideal HDR mode. The DisplayHDR 400 mode works well for bright outdoor scenes. However, the 1,000 nit mode works best for darker scenes with bright highlights, where the latter can achieve greater highs.

But long story short, and assuming you can get your hands on one, this is the 32-inch 4K QD-OLED panel we'd go for. It's cheaper than the alternatives, with no significant downsides in features or performance. As no-brainer recommendations go, this is about as straightforward as it gets. **–JEREMY LAIRD**

VERDICT **9**

MSI MPG321URX

+ A NEW HOPE Much cheaper than other 4K OLEDs, and just as good.

− CLONE WARS Still not exactly affordable; You might prefer an ultrawide.

$899, www.msi.com

SPECIFICATIONS

Screen size	32-inch
Resolution	3,840 x 2,160
Brightness	250 nits full screen, 1,000 nits max HDR
Color coverage	99% DCI-P3
Response time	0.03ms
Refresh rate	240Hz
HDR	DisplayHDR 400 True Black
Features	Samsung QD-OLED 3rd Gen panel, Adaptive Sync, 1x DisplayPort 1.4, 2x HDMI 2.1, 1x USB-C with 90W PD, KVM switch

MSI Stealth 16 AI Studio A1V

Curious design held up by an RTX 4090

OKAY, THIS THING isn't a cheap laptop. At near enough $4,100, it's eye-wateringly expensive. MSI has flooded its Stealth 16 AI Studio A1V (seriously, who picks these names?) with as much hardware and top-tier kit as it can find, and yet still, it leaves us wanting more.

Top highlight features? Intel Core Ultra 9 185H processor, 64GB of DDR5 @ 5,600, RTX 4090 with 16GB of VRAM and a crisp, clean, 3840x2400 120 Hz Mini LED display (not OLED, yes this is the first faux pas), combined with a 2TB Samsung PM9A1 PCIe 4.0 SSD (the second faux pas). That's a lot of grade-A hardware, and it's even got its own SteelSeries keyboard and trackpad, too.

So why the glum face? Well, aside from a rear illuminated light strip with the word 'Stealth' lit up in pearly white lights, there's little here that really shouts about just how high-spec this thing really is. The chassis is a simple navy plastic construction, the bezel is a little too thick, the keyboard feels pretty average under touch, and the speakers are just good, not great. That's problematic, given that price, but it is sort of understandable.

The thing is, MSI's Stealth 16 AI Studio range actually starts at $2,100. For that, you still do get the Core i9 Ultra with its AI NPU, but it's just toned down everywhere else. The big thing, though. is that the chassis and the I/O are identical. That's allowed MSI to shave some cost off the hardware bill in the process, but it does feel underwhelming when you realise that you've forked out $4,000 for a plastic box that gets greasy fingerprints on it faster than you can shout "Mystic Light".

Otherwise, performance is about where you'd expect. With that dedicated GPU in Blender, it absolutely rips, scoring some of the highest figures we've seen for a laptop GPU (even with the RTX 4090's cut down 16GB of VRAM). Jump in game at that native 4K(ish) 16:10 resolution, and the GPU dominates here, too. It does suffer somewhat in the CPU department, getting outpaced by full-fat Intel solutions and its AMD counterparts, but the battery savings do make up for that.

It also packs in a slick 120 Hz Mini-LED display, complete with some stunning colors and impressive brightness. Not having OLED is a bit of a swing and a miss, particularly at this price point, but as this is theoretically aimed at the 'professional' market, where broader access to color accuracy is key, then there's certainly an argument to be had for going with Mini-LED.

The other faux pas is the lack of a PCIe 5.0 drive. We get it—5.0 drives are toasty and require active cooling, which is already heavily compromised here thanks to the internal spec, but still, and I'll say it again, this is a $4,000 laptop.

One big positive, though, is that battery life. We also ran PC Mark's battery tests, both for modern office and gaming, and the Stealth scored a respectable 119 minutes in the gaming test, and 372 in Modern Office. That's seriously impressive, as those aren't exactly power-efficient benchmarks, either.

So, should you buy it? Well, it depends. If raw performance is the name of the game, the Stealth 16 won't disappoint. Despite its missing kit, it delivers some impressive figures both in-game and out of it, and that color-calibrated display is a real treat. That said, if you're looking for something that feels a little bit more premium, you might want to look elsewhere. **–ZAK STOREY**

VERDICT

8

MSI Stealth 16 AI Studio A1V

+ UNDER THE RADAR Solid internal spec; Okay build quality; Good screen; Decent performance across the board; Epic battery life.

– NITROGLYCERIN Mildly underwhelming design for $4,100; No 32GB option; Lacks OLED and PCIe 5.0.

$4,100, www.msi.com

BENCHMARKS

	MSI Stealth 16 AI Studio A1V	Asus Vivobook S 15 Copilot	Huawei MateBook D 16 2024 (EU Only)
Crossmark Aggregate (Index)	1,645.00	1,168	**1,938**
GeekBench 6.2.1 Single-Core / Multi-Core (Index)	2,405 / 11,173	2,444 / 9,008	**2,605 / 12,568**
Blender (Index)	**2,863 / 1,410 / 1,418**	N/A	70.22 / 40.94 / 28.38
CrystalDiskMark 8 Read/Write (MB/s)	**7,076 / 5,248**	5,024 / 3,623	4,905 / 3,952
3D Mark Wildlife Extreme	**27,121**	6,091	13,731
Total War: Warhammer 3 Ultra @ Native Resolution (avg fps)	**40**	4.1	DNC
Borderlands 3 Ultra @ Native Resolution (avg fps)	**49.1**	3.3	10.3
Price (USD)	$4,100	$1,270	$1,200

All benchmarks performed with a clean install of Windows 11, with the latest updates, chipset and drivers installed. Best scores in bold. Games tested at device's native resolution. Borderlands 3 tested at Ultra, Total War: Warhammer 3 tested at Ultra. Prices correct at time of writing.

SPECIFICATIONS

CPU	Intel Core Ultra 9 185H
GPU	Nvidia GeForce RTX 4090 16GB
RAM	64GB DDR5 @ 5,600 MT/s
Storage	2TB Samsung PM9A1 PCIe 4.0 M.2 SSD
Screen	16-inch 3840x2400, Mini-LED, 120 Hz
Connectivity	2x USB Type C (1x Thunderbolt), 1x USB 3.2 Type A, Micro SD Card Reader, HDMI 2.1, 4-pole Mic/headphone jack, WiFi 7, 2,5G Ethernet, Bluetooth 5.4
Dimensions	14.01 x 10.22 x 0.79 inches
Weight	4.39lbs

MSI's Stealth lineup mixes a slim form factor with top-tier hardware, but is it enough?

OneXPlayer X1

Is a fat tablet still a handheld gaming PC?

THE ONEXPLAYER X1 is definitely one of those 'if only' devices. If only the Meteor Lake silicon was efficient enough to deliver a game-changing level of handheld battery life. If only the Xe GPU architecture was more reliable in nailing consistent gaming frame rates across the board. If only those controllers weren't so hollow, confidence-sapping, and didn't get in the way. If only it wasn't designed to work with a magnetic keyboard.

In fact, this gaming tablet is a faintly ridiculous-looking device when you've got the keyboard and elephant-ear controllers attached. OneXPlayer is presenting the X1 as a three-in-one device: a tablet PC, a laptop, and a gaming handheld. Inevitably, it fails to excel in any of those form factors. Worse, it often isn't actually good at all.

Strangely, it's at its worst as a gaming handheld PC, and that's all down to the controller peripherals. For starters, the keyboard will happily flip up, but nothing is holding it in place, so it'll flap down again with enough force to disconnect, sending it flying. That action of flapping about will also wake up a sleeping X1, which is going to do nothing good for its battery life.

Neither will connecting the controllers to the side of the device. This isn't because they're particularly draining in and of themselves, but because they completely stop the X1 from entering sleep mode for anything more than three seconds at a time before the screen pops back on. It's pretty hopeless.

What's more, there's the feel of the controllers themselves, which move a lot in their positions on either side of the screen and the buttons don't quite map properly onto the device. They also feel too light, but worst of all, the decision to offset the thumb sticks here makes the right stick mostly unusable in-game. Normally, I prefer an offset Xbox controller layout, but here, you have to contort your thumb too much in order to be able to use both the stick and the trigger/shoulder buttons comfortably.

Then we come to the insides and the actual gaming performance. The Intel Meteor Lake CPU at its heart has a relatively powerful iGPU in it. Theoretically. If you were to take the 3DMark scores in isolation, it would seem to be the most powerful gaming handheld on the market. Unfortunately, Intel's Alchemist GPU architecture still can't be trusted to give consistently high performance across a suite of games. Sometimes, it will just about match the Radeon 780M in the Ryzen 7 7840U/Z1 Extreme chips, while at other times it will fall well behind.

If there were some redeeming feature to using the Meteor Lake chip, there wouldn't be so much of a problem. I could deal with the fact that sometimes I might end up with 10 percent less gaming performance if I was getting a huge chunk more battery life. But the Intel chips are just not that much more efficient, even running at the same TDP, compared with competing AMD processors. I'm still only getting an hour and 15 minutes in the PCMark 10 gaming battery life test at full power, while the Ayaneo Kun is just 60 seconds shy of two hours.

If all that wasn't enough, we haven't mentioned the price. Like all of the OneXPlayer devices, it's very expensive—more so even than Asus and Lenovo's handhelds. This X1 is $1,100 for the standard bundle with the controllers and magnetic keyboard. You could buy a laptop with consistently better gaming performance and a Steam Deck for that. I just don't want to use the OneXPlayer X1 as a laptop analog, or as a handheld gaming PC, meaning it's only the chonky tablet PC mode that actually works—and only then for *Football Manager* in bed, graphical glitches and all. **–DAVE JAMES**

VERDICT

5

OneXPlayer X1

+ CHOICE Novel features and form factor; 11-inch screen.

− CHONKY Multiple form factors don't really work; Very expensive.

$1,100, www.onexplayerstore.com

BENCHMARKS

	OneXPlayer X1	Ayaneo Kun	Asus ROG Ally
Cyberpunk 2077 1080p Ultra (fps)	**6**	5	5
Hitman 3 1080p Ultra (fps)	45	44	**48**
Horizon Zero Dawn 1080p Ultimate (fps)	26	**31**	30
Metro Exodus Enhanced 1080p Ultra (fps)	12	**17**	16

Best scores are in bold.

SPECIFICATIONS

CPU	Intel Core 7 Ultra 155H
Cores	16
Threads	22
GPU	Intel Arc
Memory	32GB LPDDR5x-7467
Screen size	11 inches
Native resolution	2,560 x 1,600
Refresh rate	120 Hz
Storage	1TB SSD
Battery	65 Wh
I/O	1x Oculink (PCIe 4.0 x 4), 2x USB 4 Type-C, 1x USB 3.2 Type-A, 1x 3.5mm audio, 1x TF Card 4.0
Dimensions	9.92 x 6.4 x 0.5 inches
Weight	1.74lbs

© UNSPLASH

The OneXPlayer X1's form factor is a little clunky and a lot chonky.

Asus ROG Zephyrus G14 (2024)

Our favorite 14-incher is back and better than ever

SLEEKER, SHINIER, and now with the most recent AMD Ryzen mobile processors, give it up for the latest Asus ROG Zephyrus G14 for 2024. Without wanting to give away too much, too soon, it looks, feels, and performs better than ever.

The most immediately noticeable improvement with the new G14 is the all-aluminum chassis. Built from CNC-machined aluminum and covering the laptop from head to toe, it's a big improvement in both look and feel over the previous model, which uses some plastic parts. The underside is now aluminum where it was once flexible plastic, which should strengthen it, though one downside is how hot it gets to the touch while gaming.

The new G14 chassis also helps shed some thickness—the new model comes in at 0.62 inches, compared to 0.78 inches on the previous model. Moreover, the new styling makes the G14 feel like a direct competitor to the likes of the Razer Blade 14. The all-metal body and slightly more subdued lighting system on the lid—a single strip of programmable white LEDs runs diagonally across it—make the G14 feel a much more premium device.

Specs wise, AMD's Ryzen 9 8945HS serves eight cores and 16 threads of Zen 4. It's a powerful chip for both gaming and multithreaded tasks, such as editing, but not massively different from the AMD Ryzen 7 7940HS that preceded it in earlier G14 models. Likewise, it has an NPU to accelerate some local AI workloads, but it's not fast enough to qualify as an official AI PC, according to Microsoft's new Copilot+ standard, for whatever that's worth.

Our review unit is configured with an RTX 4070 mobile GPU, which is really a rebadged 4060 Ti desktop or thereabouts, minus some clock speed, thanks to a 90W power limit. Still, the G14 stays well ahead of the RTX 4060 laptops we've previously tested, and in that sense, it still feels like you're getting your money's worth from the higher-spec RTX 4070 chip—even if not quite the same level of performance you'd expect out of a chunkier, more power-hungry gaming laptop.

Meanwhile, Asus has stuffed an OLED panel into the G14, which makes for an effectively limitless contrast and a vibrant palette—a DisplayHDR True Black 500 rating sees to that. OLEDs are also great for gaming thanks to snappy response times, and this is rated to 0.2 ms and a 120Hz refresh rate. G-Sync and Adaptive Sync keep everything silky, no matter which GPU you're gaming on, too.

With a native resolution of 2880 x 1800, the G14's resolution also has both higher vertical and horizontal resolution than your average 1440p panel. The extra pixels and screen space make for a crystal-clear picture with a high pixel density, but saps further performance out of the already power-limited GPU.

Another highlight involves the audio—the speakers are rather impressive. The range of response is great—there's more low-end than you'd expect from such a slim device. The G14's secret is a pair of compact tweeters and woofer for left and right channels, making for six speakers.

Throw in a 73Wh battery, a 1TB SSD, plus 32GB of memory, and this is one well-provisioned laptop. Not only does this bring key improvements worth seeking out over last year's, but Asus has finally found the right formula to tempt even the most stringent Razer fans away from the Blade 14. The exact G14 specification here is available for $2,000—much cheaper than a comparable new Blade 14 at $2,700.

The latest Blade 14 still holds a few premium features over the G14, such as a 240Hz refresh rate and 140W TGP for the RTX 4070. But for its all-metal finish and undeniably solid spec sheet, the 2024 Zephyrus G14 is a 14-inch gaming laptop that's hard to pass up. **–JACOB RIDLEY**

VERDICT

9

Asus ROG Zephyrus G14 (2024)

+ UPGRADES New all-metal chassis is slick; OLED screen is very sweet.

− NEEDS WORK GPU wattage is a little bit limited.

$2,000, www.asus.com

SPECIFICATIONS

CPU	AMD Ryzen 9 8945HS
GPU	Nvidia GeForce RTX 4070 (90W)
Memory	32GB LPDDR5X
Storage	1TB NVMe SSD
Screen size	14-inch OLED
Resolution	2,880 x 1,800
Refresh rate	120Hz
Battery	73Wh
Dimensions	12.25 x 8.7 x 0.62 ~ 0.64 inches
Weight	3.3lbs

AMD RYZEN AI 9
GEFORCE RTX
nvidia G-SYNC

© UNSPLASH

Asus has revised one of the best compact gaming laptops and made it even better.

Despite being a gaming monitor, the design isn't too extreme.

Gigabyte Aorus FO32U2

Does it all for gamers and professionals alike

© UNSPLASH

OLED DISPLAY TECH and 4K resolutions make a potent combination, and the Samsung QD-OLED panel that this Aorus monitor is built around has become a bit of a favorite among manufacturers. You'll find it in screens from Samsung itself, as well as Asus, and Gigabyte has jumped on board, too, with the FO32U2.

Luckily, it's pretty good. With a 240Hz refresh rate, you're going to need an ungodly GPU to drive it to its maximum at 4K, but this does at least add a degree of future-proofing, as an RTX 6080 will be making its way into your rig eventually.

At 32 inches, the screen makes a definite statement when arranged on a desk—buy two for the ultimate power move!—its widely splayed foot giving it solid support without the wobble that can creep in if a monitor stand is insufficiently stiff. It attaches firmly to a recess in the back that also serves as the VESA mount, while the foot attaches via a single thumb-turned screw. There's plenty of adjustment on offer.

Power is supplied by an external brick, which helps keep the profile of the screen thin at the expense of there being some extra clutter behind your desk, and something else to potentially catch your foot on. Still, it leaves the monitor itself looking impressively svelte, and the bit where the inputs attach—and the workings of the monitor are—looks chunky by comparison. Those inputs don't include a DisplayPort 2.1 (there's a Pro model that has it, plus extra wattage for the USB-C charging it provides), so you'll have to use Display Stream Compression, resort to HDMI 2.1, or step down to 1440p for the full speed over DP. This will probably be more than enough for the majority of PCs trying to output at that kind of frame rate, however. The USB-C port is an interesting addition, as it not only allows you to one-cable your laptop, charging it slowly at 18W while accepting its video stream, but also opens up the USB hub. There's a USB Type-B cable to connect to a second PC, so you can share a mouse dongle or other device between them. There are only two ports, and they're both Type-A, but it's nice to have.

Attach a streaming stick to one of the HDMI sockets, and you can use picture-in-picture mode to keep an eye on the sports results while you're working, though you could just do this via a web browser and it's probably useful for streamers using a second PC, or you could stick a games console on if you want to use all the ports. The size and resolution of the screen allow for all kinds of tricks like this, splitting it into four using Windows' app snapping essentially gives you four 1080p laptop screens to look at in glorious HDR.

If you prefer to use a single app full-screen, the colour response of the FO32U2 is excellent. Videos and photos can be displayed accurately, brightly, and with good saturation, making this a viable choice for the kinds of content creation that doesn't involve streaming games. The presence of the USB hub pushes it further toward studio suitability, as the reachable ports mean you're not scrabbling around on the floor to get to the back of a workstation, and you can easily switch to your MacBook, but it's gaming that's at the heart of this screen's design, so hooking it up to a rig with the kind of graphics card that can make it really sing. Time to upgrade. **–IAN EVENDEN**

VERDICT

9

Gigabyte Aorus FO32U2

➕ **HALL MONITOR** A big, bright 4K OLED with the refresh rate of your dreams.

➖ **MONITOR LIZARD** Heavy; The external power brick creates clutter.

$1,099, www.aorus.com

SPECIFICATIONS

Panel	32in QD-OLED
Resolution	3,840 x 2,160
Colour	10bit
Refresh rate	240Hz
Inputs	1x HDMI 2.1, 1x DisplayPort 1.4, 1x USB-C (18W PD), mic jack, earphone jack
Hub	2x USB 3.2 Type-A, 1x USB 3.2 Type-B
Speakers	2x 5W
HDR	VESA DisplayHDR True Black 400
Colour response (claimed)	99% P3
Brightness (claimed)	250 nits
Dimensions	28.25 x 24 x 6.2 inches
Weight	18.8lbs

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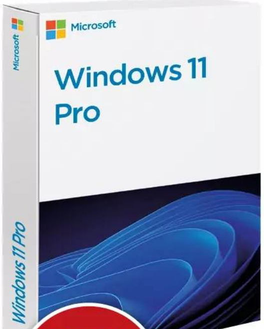

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software.maximumpc.com

NZXT H7 Flow

One of the cleanest modern chassis designs out there

STRAIGHT UP, let's just say that this is a very run-of-the-mill chassis. It looks, acts, and behaves as any good PC case should. You're going to install your next rig in it, and it's going to be super easy, and super clean all round. Even without BTF, this thing is going to get the job done.

But it's far more than that—the NZXT H7 Flow has seen iteration on iteration on iteration over the years. For many case manufacturers, every few years they'll typically flatten their entire inventory, and instead opt for a brand new naming scheme and completely new designs, built from the ground up for the modern audience, usually latching on to the features that are most prominent from their competitors at the time.

In NZXT's case, however, it did that many years ago, and to be honest, that was mostly on the naming front rather than throwing out the kitchen sink. Yep, in 2016, we first reviewed the S340 from the plucky company, a complete redesign on its previous lineup, featuring that now dominant, super-slick cut-throat aesthetic, cable-management galore, and fairly reasonable airflow.

Since then, the company has gone from strength to strength, slightly tweaking that same model year on year—a little bit more clearance here, better cable management there, some I/O tweaks on this bit, recessed fans on that bit. All of a sudden, what you're left with is the latest NZXT H7 Flow 2024 edition, and it feels special.

It's a podium of power, lifted off the ground by no small margin with a radically dynamic stance. The PSU has been rotated in the rear to save space and make way for three floor-mounted fans of your choosing. The front panel, now almost entirely perforated, boasts incredible access to airflow, and the internal layout supports even more cooling, too.

Jump around the back, and there's an armada of cable channels, cable bars, velcro straps, and more, all carefully positioned to help route everything to exactly where it needs to go. It's all easy to access—the panels are super simple to shift off the chassis, and there's a removable radiator bracket in the front as well. If there's something you can think of that you want in a reasonably priced mid-tower, it's likely the NZXT H7 Flow supports it.

To finish off, there are four variants: non-RGB, RGB, and black or white variants of those configurations. The price difference between them is just $20, but both get access to three fans as standard, so you're simply paying for RGB.

This is absolute design evolution in action: beautiful to look at, and will make whatever system you stick in it absolutely shine. Compared to the 2022 version, it's leaps and bounds ahead. It's just almost without fault. The case market is really heating up this year, and if you're a manufacturer you better be bringing something that's on par with this H7 Flow or the Phanteks XT View if you're going to compete. **–ZAK STOREY**

VERDICT
9
KICK ASS!

NZXT H7 Flow

➕ **FLOW STATE** Outstanding design language; Intense cable management; Roomy interior; Expansive cooling support; Multiple colorways; Reasonably priced.

➖ **FLOATERS** No BTF support.

$129.99, www.nzxt.com

SPECIFICATIONS

Motherboard Support	ITX, Micro-ATX, ATX, E-ATX (12x11 inches)
2.5-inch / 3.5-inch Support	Up to 5 x 2.5-inch, or 2x 3.5-inch and 3x 2.5 inch
Max Radiator Support	120mm Rear, 360mm Roof, 240mm side
Fan Support	1x 120/140mm Rear, 3x120/2x140mm Roof, 3x120mm floor, 2x120mm Side
Dimensions	17.32 x 9.05 x 19.68 inches
Graphics Card Clearance	Up to 410mm
CPU Tower Clearance	Up to 185mm
Warranty	5 years limited

SteelSeries Arctis Nova 4 Wireless

Budget wireless cans with top-tier audio

FINDING A BUDGET wireless headset that actually delivers well-balanced, well-rounded audio has always been a challenge. Let's face it, we've only just got wired gaming headsets that fit the bill at the $100-150 mark, never mind ones that have to navigate the wild west of 2.4GHz wireless as well, plus stack a decent battery life on top.

Fortunately for us, the Arctis Nova 4 Wireless exists, and it absolutely slaps when it comes to top-quality audio. That's not exactly surprising though, given SteelSeries' pedigree when it comes to top-quality audio headsets. Let's be clear: listening to music through these over Wi-Fi, dialed in with my favorite EQ preset, gave this journalist goosebumps, something we're just not used to with headphones at this price.

So yes, the biggest positive here is audio quality. Bass is immense, but it doesn't muffle the mids or crush the treble. There's a breadth to it that's genuinely impressive for a sound-stage over wireless. It's not going to match some of the more premium options above and beyond the $200 mark, but for what you're paying, you'd be hard-pressed to tell the difference between it and, say, the $200 Corsair Virtuoso Pro or something similar. It's well rounded and punchy.

As for the headset itself, there's a lot to like here, too. SteelSeries is still taking advantage of its ski-band headband design. It's worth pointing out that these are notorious for sagging as the headset gets older and more worn. Fortunately, SteelSeries has looked to fix that by including a number of notches in the headband, allowing you to tighten it up again for a time. Failing that, it'll even sell you replacement bands if you need to replace it because of that reason, or you're just keen to shake things up with a bit of a new style.

Overall build quality isn't going to blow anyone away—it's a mostly plastic affair here. There's some soft cushioning on the ear cups, but it isn't memory foam. The cloth is fairly soft, though, and there's no irritation here. Speaking of the ear cups, they're on the small side, so that could cause some trouble, depending on your own characteristics, but that's about it. Branding wise, this is absolutely not a 'looks great in the office and your gaming room' set of headphones. It's very much a gaming headset: the shape, style, headband, logos, and included stickers all point to that. That's not necessarily a bad thing these days, given just how many professional-looking headsets that are out there, blurring the lines between the two hobbies. It's nice to see SteelSeries take up that mantra of being a premium 'gaming-focused' company instead.

Adjustment is pretty stellar, too. There's full rotation on the earcups, and the headband can be pulled up and down, extending above each can. Onboard controls are fairly standard—you have a power button, volume wheel, mic mute, and that's it. Interestingly, the volume wheel is separate to Windows' own volume, so you can really ramp up the audio levels here. That's pretty stellar, given how often headsets tend to babysit people nowadays.

One downside is the mic. It's a retractable unit, but if the headset's on your head, it's incredibly hard to find. When in use, it's audible and clear, but not exactly exemplary. If you've used a gaming headset since 2013, you'll be familiar with this one. Noise canceling on it is fine, but no more than that.

One last plus is the USB-C WiFi adapter. Finally, something to plug into those ports on the rear of your motherboard, although SteelSeries does include a USB A to C adapter as well. Oh, and the battery life clocks in at 35 hours per charge—not at all shabby.

Right now, the Arctis 4 retails for around $120 or so, but we've seen it drop as low as $90. At that price, it's incredibly easy to forgive that underwhelming mic, particularly when the audio and comfort is this good. If you're looking for a decent entry-level wireless headset, you'll struggle to find better (at least at that price). **–ZAK STOREY**

VERDICT 8 **SteelSeries Arctis Nova 4 Wireless**

+ HYPERNOVA Outstanding soundstage; Good comfort levels; Lightweight; Great battery life; Decent value for money.

− NO... EUGH Mic is very average; Retail price is slightly too high; No Bluetooth.

$120, www.steelseries.com

SPECIFICATIONS

Connection	2.4 GHz Wireless (via USB Type-C Dongle with Type-A Adapter)
Type	Closed Back
Frequency Response	20 Hz - 22 kHz
Drivers	40mm Nova Acoustic System
Connector	USB C
Microphone	Retractable ClearCast Gen 2
Weight	9.24 oz

32GB Lexar Thor OC DDR5

The RAM singularity

DDR5 MEMORY is in a very peculiar place right now. When it launched, it really did suffer from some ridiculous pricing, with 4,200 MT/s kits featuring atrocious latencies that were actually slower than the average DDR4 kit, yet being way more expensive. Fortunately, over the last half year or so, memory pricing has fallen off a cliff, which is great news for us.

Lexar's Thor OC DDR5 is a prime example of what you can get on the cheap. It's $100 for 32GB @ 6,000 MT/s, and similar to the Crucial Pro Overclocking kit that we've been effusive about lately, featuring both Intel XMP and AMD EXPO profiles. That's brilliant news, as it keeps things simple. No longer do you have to find exactly the memory kit for your system—just pick the memory speed and capacity you want, and you're good to go.

Where Lexar has the edge with its Thor kit, though, is on exactly that premise: price. Lexar has eked out a fairly decent victory against some of the bigger brands by sliding this particular kit in at just $100. Most other kits come in slightly higher at around $110 for this spec. That's not much, admittedly, and you do lose out on RGB (at least compared to Adata's XPG Lancer Blade kit), and the design is... questionable, but nonetheless, a win's a win.

Across the board, performance is solid. Thanks to a super-tight C32 latency and that 6,000 MT/s speed, you're looking at a real-world latency of around 10.67ns. That's not as quick as the XPG Lancer Blade, but it's faster than Crucial's Pro Overclocking kit, and with the added bonus of being multi-platform. That doesn't necessarily transfer to our benchmarking procedure for memory, but if you're simulating a massive amount of information, or traversing huge datasets, the difference will be more noticeable.

Unsurprisingly, in-game for our Intel 14900K, the Lexar Thor OC delivers little difference. At 1080p, we're still getting 191.3fps average frames in *Total War: Warhammer 3*. Admittedly, the minimum frame rate is slightly lower than the competition, but that still falls within margin for error at 146, and we're talking 1-2fps, which is hardly game-breaking. Similarly, Puget Bench put it slightly behind the Crucial Pro Overclocking kit, but again, by less than a percent.

One area we did notice a loss was in the temperature under load testing, with the Thor running slightly toastier than most of the competition, squeaking in with a 58.5 C max. Although again, it's worth noting that's still considerably below the max temp for DDR5 (85C).

As for the appearance, it's a bit on the nose. The heatsink shroud looks and feels slightly cheap, and there's a shiny gloss to that plastic cover that reminds us of products from the early Noughties. The gold accent looks a bit dull, and the knotwork on the design looks more Celtic than Viking (but that's just us nitpicking).

No matter how you look at it, the Lexar Thor OC kit is a super budget-value proposition that delivers great performance for little outlay. 32GB is finally the norm, and reasonably priced, too. This Lexar kit proves it. **–ZAK STOREY**

BENCHMARKS

	32GB (2x16GB) Lexar Thor OC DDR5 @ 6,000 MT/s	32GB (2x16GB) Crucial Pro Overclocking DDR5 @ 6000 MT/s	32GB (2x16GB) XPG Lancer Blade RGB DDR5 @ 6000 MT/s
SiSoftSandra Overall Memory Score (Index / kPT)	2.65	**2.68**	2.27
SiSoftSandra Memory Latency (ns)	80	**78**	80
SiSoftSandra Memory Bandwidth (GB/s)	**76**	73	69
PCMark10 - Express (Index)	**6,857**	6,852	6,624
10GB WinRAR Archive Time (Seconds)	**116**	**116**	**116**
Puget Bench - Adobe Photoshop (Index)	7,529	7,532	**7,550**
Total War: Warhammer III (avg / min fps)	**191.3**/146	**191.3/148**	**191.3**/147
Max Temp Under Load (Celsius)	58.5	**51.0**	**51.0**
Real World Latency (ns)	10.67	12.00	**10.00**
Gigabyte per $ (Index)	**0.32**	0.29	0.29

Best scores in bold. Our test bed consists of an Intel Core i5-14600K, Asus Z790 Dark Hero motherboard, an Nvidia GeForce RTX 4080, Corsair H150i AIO, and an Adata Legend 960 Max PCIe 4.0 SSD. All gaming tests were performed at 1080p, on the highest preset. XMP is enabled.

VERDICT
9

32GB Lexar Thor OC DDR5

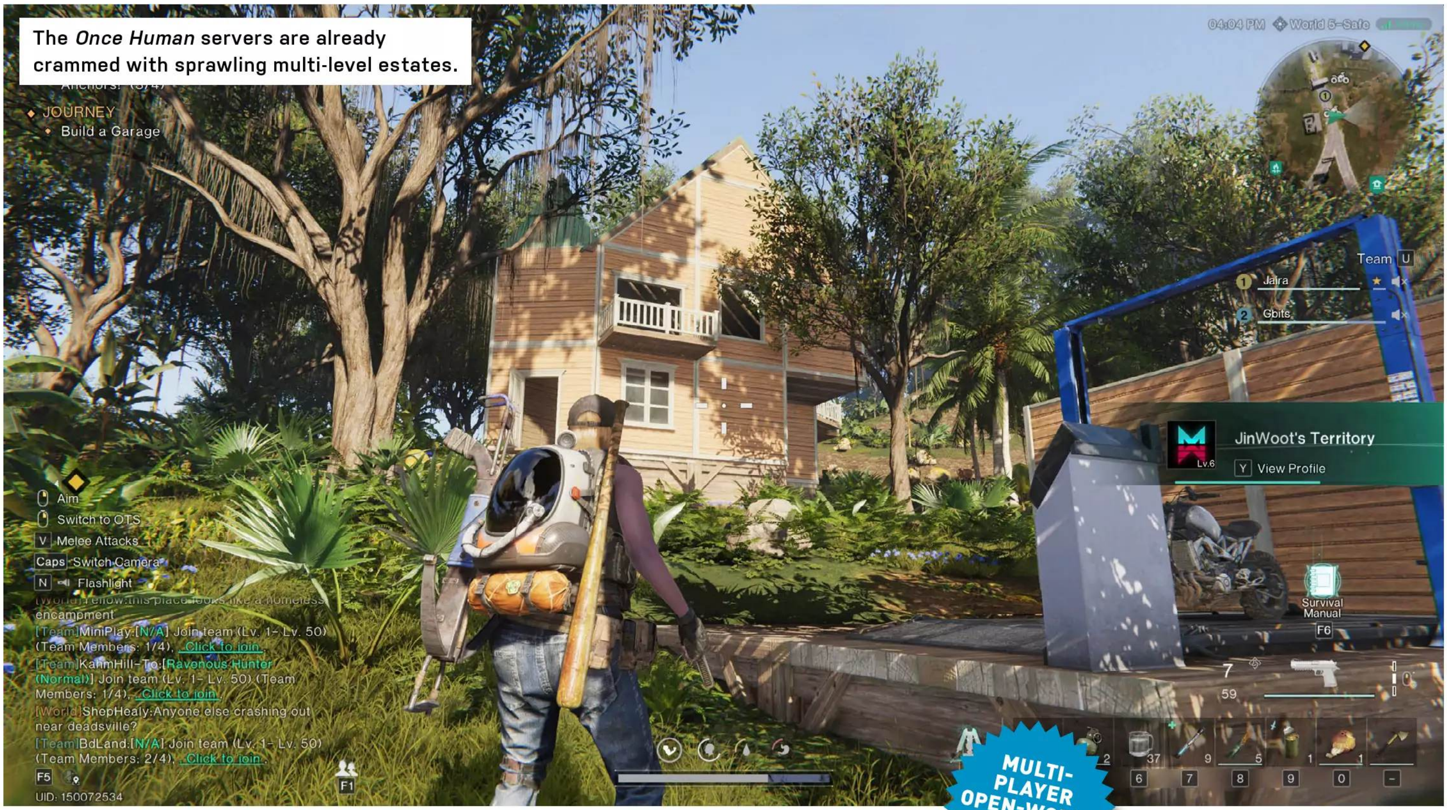
+ DRAINING THE SEA BY DRINKING IT All-round decent performance; Fantastic pricing; Great for big data work and sims.

− GETTING POISONED BY JORMUNGANDR Aesthetics are underwhelming; Slightly toasty.

$100, www.lexar.com

SPECIFICATIONS

Capacity	32GB (2x16GB)
Channels	Dual
DDR Standard	DDR5
Frequency	6,000 MT/s
CAS Latency	32
Operating Voltage	1.35V
Warranty	Limited lifetime



[World]Fellow:this place looks like a homeless encampment
[Team]MiniPlay:[N/A] Join team (Lv. 1- Lv. 50) (Team Members: 1/4), Click to join.
[Team]KahmHill-To:[Ravenous Hunter (Normal)] Join team (Lv. 1- Lv. 50) (Team Members: 1/4), Click to join.
[World]ShepHealy:Anyone else crashing out near deadsville?
[Team]BdLand:[N/A] Join team (Lv. 1- Lv. 50) (Team Members: 2/4), Click to join.

The *Once Human* servers are already crammed with sprawling multi-level estates.

MULTI-PLAYER OPEN-WORLD SURVIVAL

Once Human

Build, farm, shoot, and cooperate in this top MMO

A SURVIVAL MMO from NetEase, a developer that specializes in mobile-first games that keep you busy for about as long as it takes for your fast food order to arrive? No thanks.

But wait. While *Once Human* is far from perfect, it *is* good. In fact, for a free-to-play game, it's stunning. It's like a less cartoony, more fully fleshed-out version of creature collector *Palworld*. And that's no bad thing.

Once you're done with the detailed character creation, you jump into the game as a 'meta-human', a new mutation of homo sapiens adapted to alien 'stardust' that has turned most of the planet into monsters. Blasting through an entire room of stardust monsters is satisfying, but not remotely difficult—at least during your first 'Novice' season.

But almost immediately, you'll begin crafting and building, using basic resources that are lying around. Like every system in *Once Human*, building is deep and complex, and players are already showing off incredible, sprawling multi-story estates online.

Many of the objects are interactive, not just things you craft for the sake of crafting them. There's a mirror that lets you remake your character, a piano you can play for your friends in game, and a mailbox that actually gets mail. Then there's my Logging Beaver that brought me a dining chair. For real.

Every single system is layered deeper than you'd expect—food you carve from beasts or harvest from fields expires quickly, so you'll want a stove, fridge, and meat dryer. But wait—you need salt, too, and to get that you're going to have to visit the sea, harvest sea water, and use the stove to turn it into salt. Then, if you eat dried meat, you're going to get thirsty faster because of the salt content. It goes on and on.

This unexpected depth extends to *Once Human*'s creature collecting. These 'Deviants', including the aforementioned beaver, can help you collect resources or fight alongside you. But they also require their own things to perform at their best, like lights of a particular color, music from a radio, or plants or flowers.

However, when it's time to shoot, things shift from dead complicated to dead easy. With fully upgraded gear and weapons, everything in the open world can be offed with a single headshot, and bosses are mostly sponges. Enemy AI is fairly stupid and slow. Moreover, for an MMO, there are very few encounters that truly require playing with or against other people, though you'll see them everywhere, and their houses and the temporary tents they're using as respawn points.

Many dungeons can be done solo. It would be a shame to do them all that way, because co-op brings a new level of fun to *Once Human*, allowing you to blaze through enemy areas with even more abandon. For the record, all the servers currently available are 'Novice', but that's probably going to ramp up in future seasons.

There are flaws, of course. For starters, whoever designed the menu systems obviously struggled with where to put everything. Character tasks and progression are separated into at least five different trees, which are frequently buried frustratingly deeply in menus, for instance. In some ways, this is all part of what makes the game fun. Every little thing has five or six minigames built into it, but finding all those minigames when

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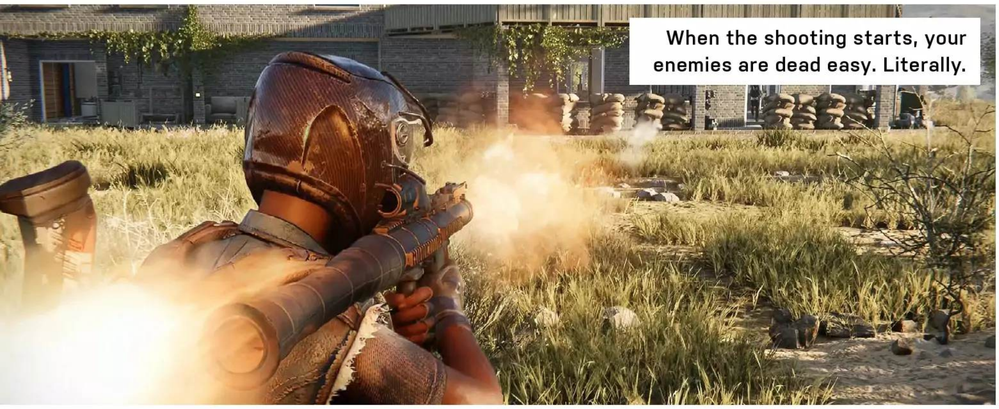
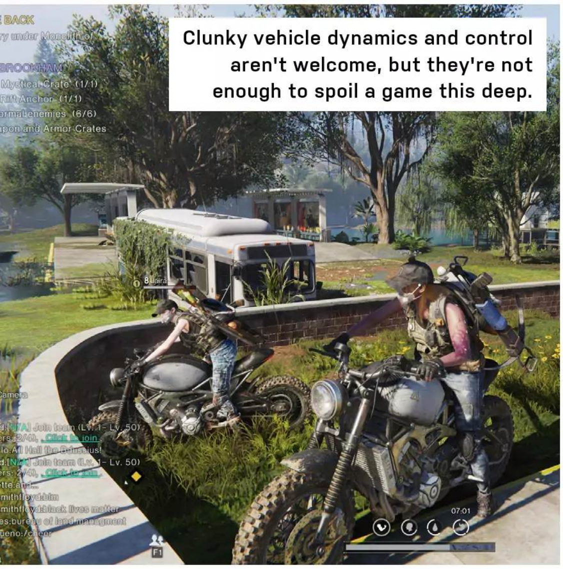
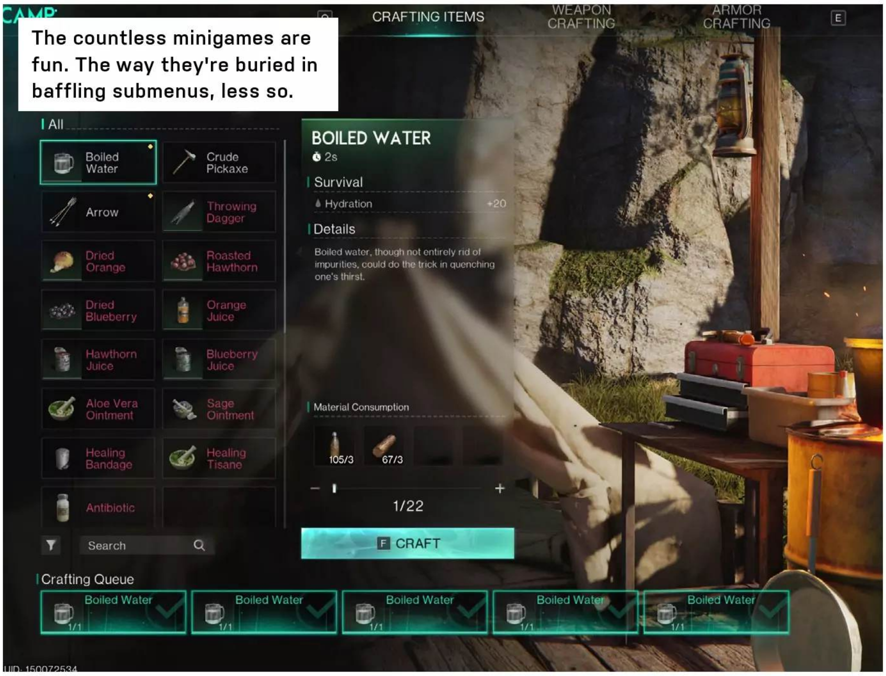


When the shooting starts, your enemies are dead easy. Literally.

Why not indulge in a spot of fishing?



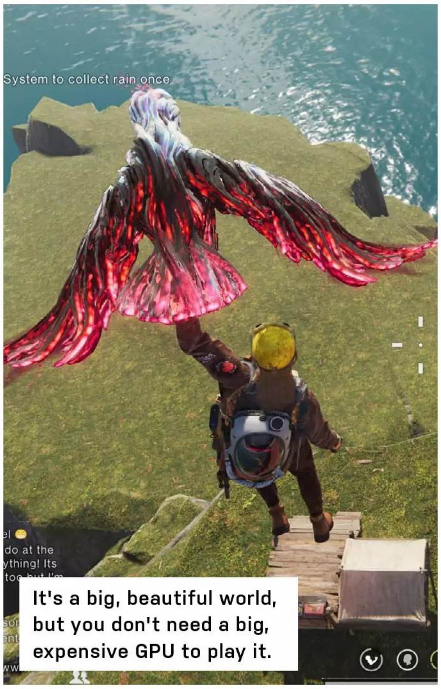
Clunky vehicle dynamics and control aren't welcome, but they're not enough to spoil a game this deep.



The countless minigames are fun. The way they're buried in baffling submenus, less so.

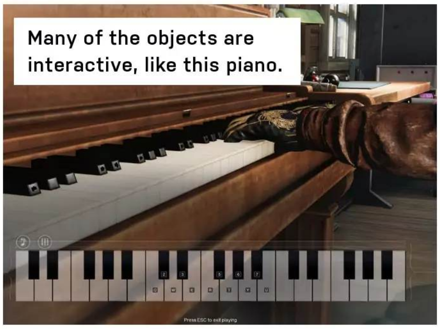
CAMP
CRAFTING ITEMS
WEAPON CRAFTING
ARMOR CRAFTING
All
Boiled Water
Crude Pickaxe
Arrow
Throwing Dagger
Dried Orange
Roasted Hawthorn
Dried Blueberry
Orange Juice
Hawthorn Juice
Blueberry Juice
Aloe Vera Ointment
Sage Ointment
Healing Bandage
Healing Tisane
Antibiotic
Search
BOILED WATER
2s
Survival
Hydration +20
Details
Material Consumption
105/3
67/3
1/22
F CRAFT
Crafting Queue
Boiled Water 1/1

Boiled water, though not entirely rid of impurities, could do the trick in quenching one's thirst.



It's a big, beautiful world, but you don't need a big, expensive GPU to play it.

There are more layers to this world than might appear.



Many of the objects are interactive, like this piano.

you know they exist, but don't remember which menu tree/tab/option they were in, gets old very quickly.

There are other niggles: driving vehicles is via WASD with no mouse control, which is just as clunky as it sounds. You also have to accept two hard-to-kill PC processes that run in the background as part of *Once Human*'s security layer, and it insists on running in Admin mode, which it does not really have an excuse to do. But in the grand scheme of things, those are minor annoyances for a game this deep, this engaging, and this free. –**HEATHER NEWMAN**

VERDICT

8

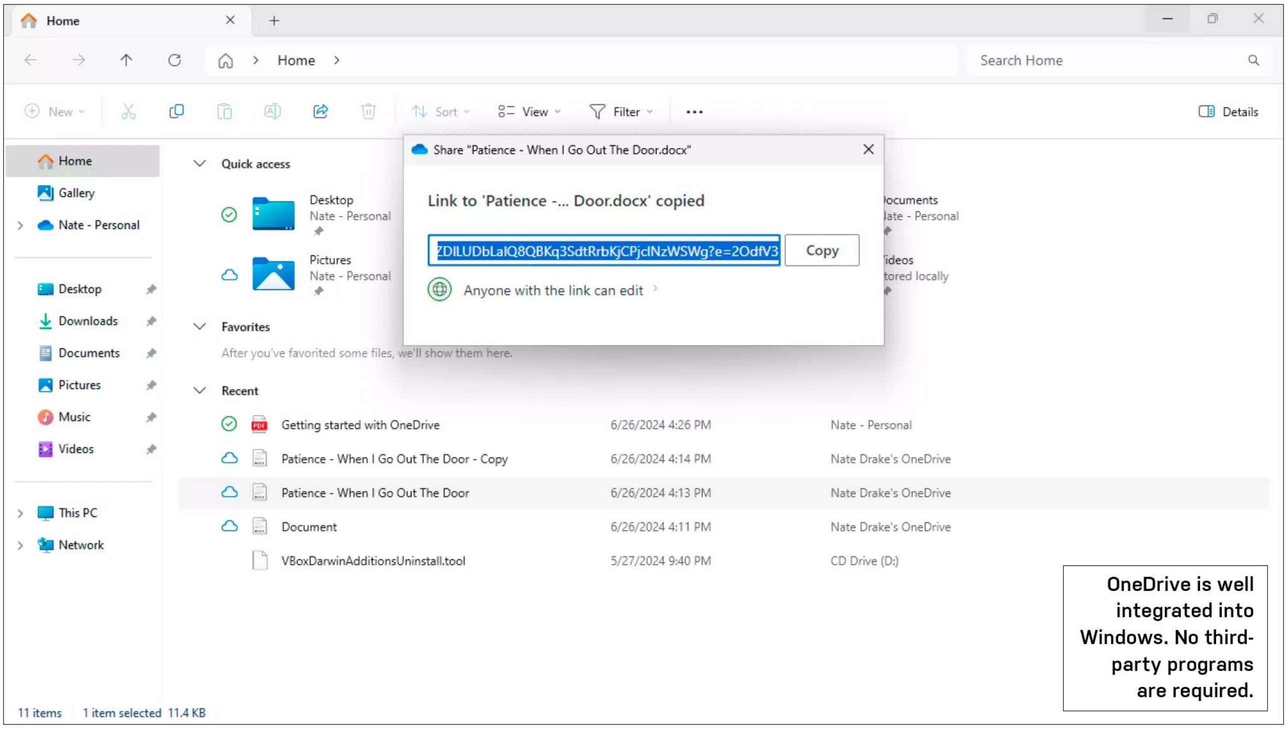
Once Human

BUCKET LIST Far better than you'd think; Incredibly rich and layerer; Free.

SICK BUCKET Baffling menu system; Poor vehicle control; Runs in Admin mode.

RECOMMENDED SPECS CPU, Intel Core i7-7700. GPU, Nvidia GTX 1060 6G, AMD Radeon RX 580, or Intel ARC A380. RAM, 16GB. 55GB storage.

$Free, oncehuman.game, rated 17+



Share "Patience - When I Go Out The Door.docx"

Link to 'Patience -... Door.docx' copied

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Anyone with the link can edit

After you've favorited some files, we'll show them here.

Getting started with OneDrive	6/26/2024 4:26 PM	Nate - Personal
Patience - When I Go Out The Door - Copy	6/26/2024 4:14 PM	Nate Drake's OneDrive
Patience - When I Go Out The Door	6/26/2024 4:13 PM	Nate Drake's OneDrive
Document	6/26/2024 4:11 PM	Nate Drake's OneDrive
VBoxDarwinAdditionsUninstall.tool	5/27/2024 9:40 PM	CD Drive (D:)

OneDrive is well integrated into Windows. No third-party programs are required.

OneDrive vs Google Drive

The tech titans clash in the field of cloud storage

TECH GIANTS Microsoft and Google each offer their own respective cloud storage services and web apps.

OneDrive is built into Windows, so requires minimal setup. Windows 11 actually requires you to sign in via a Microsoft account during setup. This means, in theory, that every Windows user has at least a free OneDrive folder, so can automatically start backing up and syncing content. This plays well with Microsoft 365 users, as the free web versions of apps like Word and Excel can save files to your OneDrive folder.

There may therefore seem little reason to use Google Drive. After all, it entails setting up a separate account and app. The 15GB of free cloud storage is more generous, but both Microsoft and OneDrive offer similar pricing plans for extra space, starting from around $2 per month for 100GB. Both services also offer comparable security, file versioning, and online editing of documents via their respective app suites.

Still, when you look under the hood, there are some subtle differences. Google Drive, for instance, is part of a vast range of 'Workspace' apps, meaning it's ideal for businesses who need to sync and share large amounts of data quickly.

On the other hand, OneDrive uses block level copying. This means that when a file is first synced to the cloud, every bit of data is uploaded. However, when changes are made, only the altered data blocks are sent. This makes for much faster and more efficient file synchronization.

Both Microsoft and Google also encrypt data packets during transit, but neither use 'zero knowledge' encryption. In other words, if a cloud server is breached or seized, your data could be at risk unless you've encrypted it yourself.

ONEDRIVE

Microsoft's self-described 'cloud service' began its life in August 2007 as SkyDrive. In 2013, after a very public lawsuit with TV broadcaster Sky UK, the service was renamed. This hasn't been the only change, as over the years, the amount of storage offered has gone from unlimited (for Office 365 subscribers) to just 5GB of free cloud storage. This is mitigated by an additional 15GB of mailbox storage.

One of the main advantages of using OneDrive on Windows 11 is that it works out of the box. Modern versions of Windows require you to sign in with a valid Microsoft account during setup, which is all you need to take advantage of the cloud storage features.

Upon opening the OneDrive folder, there's even a user manual discussing its perks. For instance, the shortcuts in File Explorer default to the OneDrive versions of Desktop, Documents, Pictures, and Videos. In other words, anything placed there is automatically synced to the cloud.

The manual also explains that users can enable backups for the Music and Videos folder by configuring OneDrive settings. This can be accessed via the dedicated taskbar icon at the bottom right of the screen. From here, you can also automatically sync pictures and videos from connected devices to OneDrive.

Syncing works a little differently to configurations for other cloud storage services like Dropbox, as files stored in OneDrive will only appear as a shortcut in the relevant folder. Double click to download and open.

Given that OneDrive's a Microsoft product, it's hardly surprising that it integrates well with the web version of

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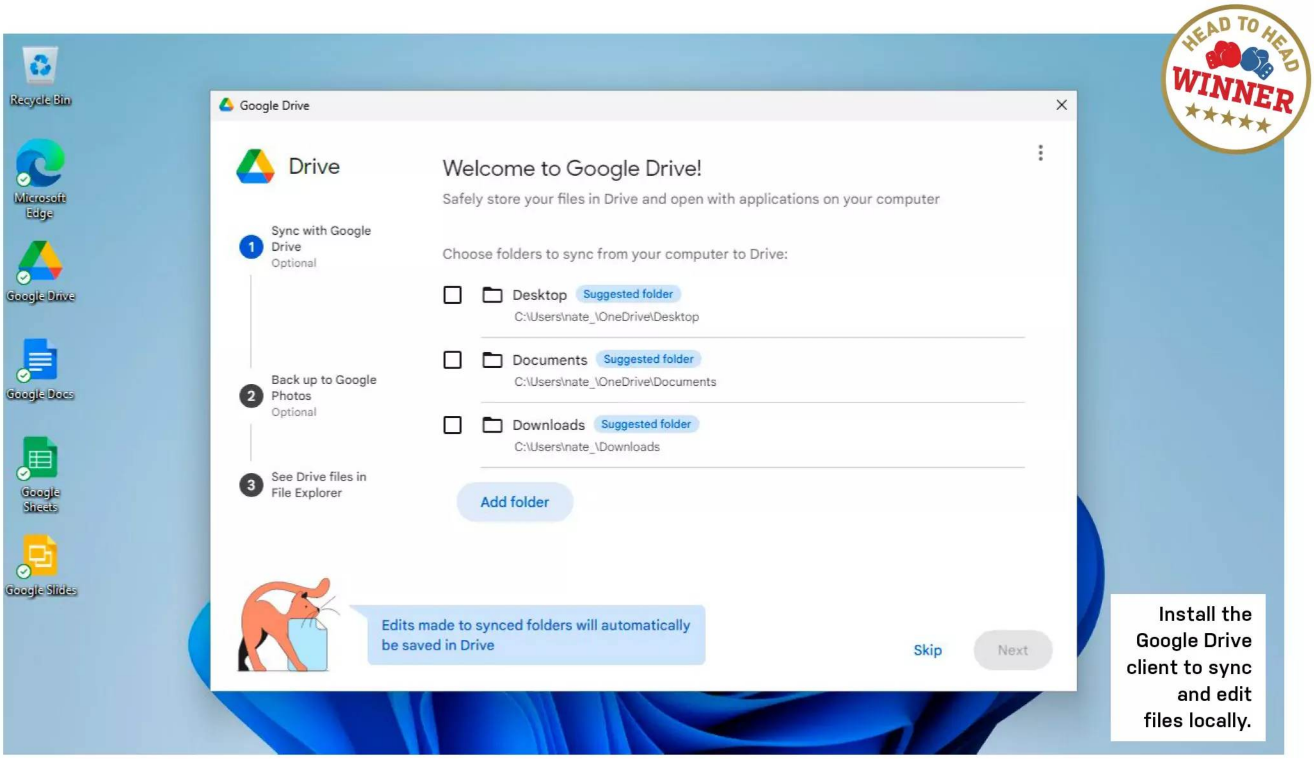

Google Drive

Drive

1 Sync with Google Drive
Optional

2 Back up to Google Photos
Optional

3 See Drive files in File Explorer

Welcome to Google Drive!

Safely store your files in Drive and open with applications on your computer

Choose folders to sync from your computer to Drive:

☐ Desktop Suggested folder
C:\Users\nate_\OneDrive\Desktop

☐ Documents Suggested folder
C:\Users\nate_\OneDrive\Documents

☐ Downloads Suggested folder
C:\Users\nate_\Downloads

Add folder

Edits made to synced folders will automatically be saved in Drive

Skip Next

Install the Google Drive client to sync and edit files locally.

Microsoft Office (Microsoft 365). You can access this by visiting the relevant site, then signing with your Microsoft Account.

On sign in, you'll be prompted to upgrade to enjoy 1TB of OneDrive storage, as well as 'Premium' versions of Office apps. Any files you create can be saved to the cloud, though when we tried to save a file to 'Documents', it actually went to the root OneDrive folder instead.

Windows also makes it very simple to share OneDrive content. Simply right-click on the relevant file, then choose 'Share' to either enter an email address or copy a link. Shared folders can also be copied to another user's OneDrive folder.

Given how well OneDrive is embedded into Windows, it's surprising that there's also a dedicated desktop app you can download via the Microsoft Store. This turned out to be academic, however, as in our tests on a VM running a clean install of Windows 11, the app failed to sign in.

We had more joy with the OneDrive web portal, which showcased the Recycle Bin for deleted files. After making some small edits to a Word document, we also found that the platform supports file versioning.

GOOGLE DRIVE

Just as OneDrive requires a Microsoft Account, Google's offering requires you to sign in via a Google Account. There's a free plan offering 15GB of storage, though unlike OneDrive, it doesn't delineate between mailbox space and cloud storage space. Premium plans start from around $20 per year for 100GB of storage.

Users can point their browser to https://drive.google.com to view and upload content. Drive is just one of a number of Google Workspace apps. From here, you can create and edit files in Docs, Sheets, Slides, and more.

Google Drive shines here, as while it's not embedded into Windows, it's easy to use with other apps. For instance, you can use 'Share' to add other Google Account users as editors to a file or folder. Drive can also generate shareable links with editing/commenting rights.

File versioning is also supported, though Google only retains different versions of files for up to 30 days or 100 edits—whichever happens first. Special mention should also go to Drive's search bar, which lets you search files by name. There are also search 'chips' that let you filter by file type, the people it's shared with, and when it was modified.

During our tests, the Google Drive desktop client wasn't available on the Microsoft Store, but we were able to download it from the main site. During installation, you can add shortcuts to Drive to the desktop, along with links to Google Docs, Sheets, and Slides.

Unlike with OneDrive, there are advantages to installing the desktop client: you can open Google Drive files using applications on your computer. You can also specify folders to sync from your computer to Drive. This gives Google Drive an edge over OneDrive, as you can specify any location. You can also specify folders with pictures and videos to sync to either Drive or Google Photos.

Once setup is complete, you can access your files and folders via a virtual drive (designated G:\ on our test machine). By default, these aren't stored on your computer, but you can right-click and open the context menu to 'Make Available Offline'. Here, you can generate shareable links for files, open a file/folder via the online version of Drive, and view previous file versions. If you double click to open a file it will download and open in the default Windows application. **–NATE DRAKE**

VERDICT **8**

OneDrive

➕ **ONEDERFUL** A well-integrated Windows cloud service; Block level copying.

➖ **ONEDOWN** Minimal free storage; Limited flexibility with other web apps.

Free Tier, www.microsoft.com

VERDICT **9**

Google Drive

➕ **DRIVICTORIES** A generous free tier; Wide range of integrated apps.

➖ **DRIVEYOUCRAZY** Requires additional setup and desktop app to benefit from all features.

Free Tier, drive.google.com

© GOOGLE

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> Rad locations
> Inching ahead
> Musical PCs
> SSD beats HDD

Mounting pressure

In your July 2024 cover build (Build this AMD Marvel), I'm curious as to why the heat exchanger is mounted to the bottom of the PC, and not the top. Aren't you adding heat into the case? Why isn't this mounted at the top, like all other PCs?

It would also be nice to indicate the companies selling the items at prices you mention during the builds. You used to do that, and it made life so much easier to shop around for better pricing.

–V. Champlin

CONTRIBUTOR, ZAK STOREY, RESPONDS: This is something Guy and I discussed in the video of our Story of the Build for that issue (which you can click a link from on page 17 of the magazine, every issue).

Effectively, you can either increase your CPU temperature because your GPU heats up the air, or increase your GPU temperature because your CPU heats up the air. The difference is usually around 6-7 degrees Celsius or so.

Given how hot Intel chips are these days (being safely rated to over 100 C) and how chilled GPUs are (still floating around the 80 C mark for most Nvidia cards), you're better off leveraging that to your advantage, and using the rad as an intake with some hefty static flow fans.

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: As Zak notes, there are advantages and disadvantages to using the bottom, front, or top of your case to mount a radiator. The good news is you can't really go wrong—just be sure to monitor the system temperatures when running a game, and make sure everything's within healthy limits (I use NZXT's CAM software, but that's because I currently have one of their motherboards).

As for your question on prices and vendors, prices change so frequently, items go out of stock often, and we have lead times to contend with (it's two weeks between us closing an issue and it going on sale) that I question the usefulness of us doing this.

However, I can wholeheartedly recommend using PCPartPicker to search for any of the components we use and find where they're on sale at the cheapest price currently. Zak and I do use PCPartPicker as a reference when putting build specs together, so we could actually share that link somewhere in the build text which would help if you're trying to replicate a build. Thanks for prompting the idea!

More metric mayhem

I agreed with the reader several months ago who expressed that the weight of a laptop in grams was confusing to a US audience, and that using ounces and pounds is a better way of conveying practical info. However, now you are using imperial units for things that don't make sense. Fans in inches rather than millimeters? No one sells cooling units in inch sizes anymore! You should use the units that are attached to the products in question. If Newegg uses the metric system to describe an item, you should too! Save mention of some other unit for situations where there is no clear standard, ideally using both metric and another when it makes sense. (From a decades-long subscriber and fan.)

–D. McNamara

I'm reading Zak's review of the Phanteks XT Pro, and suddenly fan measurements are in imperial units. But then there is a typical '140mm' mention in the final portion of the article. I recall a recent American reader asked you to use imperial units more, but I think you missed where they suggested you use both units, not just crudely find-replace metric to imperial for some markets. Computer fans are one place where I see mm used almost every time—that is just the convention for

↘ submit your questions to: editor@maximumpc.com them, and I'd suggest your American audience knows the difference because they are nearly 'proper nouns' (120mm vs 140mm vs 360mm, etc.).

Also, us Canadians typically get the US edition, and therefore now I have unfamiliar units all over the place. I'm used to that to some degree—the Canadian market is smaller than just California alone—but c'mon, throw us (another non-American, English speakers) a bone here, and use two unit systems as your original reader letter suggested. That review in particular had plenty of word count to let you drop some flavor text to make room.

I don't want to blame Zak (who I'm so very happy to see back), because this just seems like sloppy editing.

–K. Weppler

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: Thanks for your emails. I can only apologize for last issue, where we went a little bit over-zealous on the measurement conversions, and a few peculiarities slipped through. As editor, I should have spotted these, but in the hectic schedule of putting last issue together, a few slipped through.

For context, we discussed the feedback we'd had from readers about imperial units as a team, and the production editor and I worked to address this. However, rather than focusing on imperial measurements for things like case sizes and weights, we converted a few more things like fan sizes when they should have remained metric. I've been very thorough this issue, and will be going forward, so I apologize for any confusion, and promise things will make more sense going forward!

If you do spot anything that doesn't make sense, or anything else we need to address, please be sure to email me on editor@maximumpc.com.

Reader M. Korn asks, why buy a mechanical drive in 2024?

© WD

Play that funky music

I'm a professional musician. Six years ago, I decided to take the plunge and assemble my first build with sound recording in mind. I focused on one of your gaming designs, made tweaks here and there, and proudly ended up with a well-performing Windows 10 computer.

Now that Microsoft has announced it will end its Win10 support in the near future, is there a chance we could actually see a *Maximum PC* Win11 audio-oriented design in a future issue? If so, it would be greatly appreciated.

–G. Valiquette

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: We always love to hear your build ideas, so thanks for getting in touch regarding an audio-focused PC for a future issue. I've sent your idea on to our resident build expert, Zak, who can look into what components deserve attention. However, it would really help if you could update us on what sort of audio production you're doing, and what it is you need. You mentioned sound recording, but is it vocals and instruments, or more like podcasting? Please let us know.

On the subject of podcasting, we did recently feature a four-page tutorial on the latest version of Audacity as the lead in last month's How-To section (August 2024, page 60). It's not Win11-specific, but it does show you how to make the most of the popular podcast editor's cloud-based features, which allow you to store your project remotely so that it can be worked on collaboratively.

In the meantime, I'd be remiss if I didn't point you towards our music production sister title, *Future Music*, which has loads of coverage on music production hardware and software, as well as interviews with people in the biz. It's available as a magazine, as well as at www.musicradar.com/futuremusic.

Why go HDD?

Your writer, Zak Storey, chose the WD Passport 6TB portable hard drive as his Editor's Pick in the August 2024 issue of the magazine. From my personal experience, I'm using a 4TB NVMe with a compact box and a USB Type-C connection to get 400 MB/sec data transfer. You can get the hardware for a really modest cost.

In my opinion, this combination disqualifies any hard disk option going forward. **–M. Korn**

EDITOR-IN-CHIEF, GUY COCKER, RESPONDS: If you look at the price of the WD drive that Zak reviewed ($190) vs the cheapest available 4TB SSDs (the Crucial P3 4TB, currently $210), then you make a fair point. Of course, you also have to factor in the cost of an enclosure for the SSD, but even that's only $16 on Amazon currently. If I was looking for a large amount of external storage in 2024, which option would I choose? Probably the SSD—it's more portable, less prone to mechanical failure, and is so much faster in terms of read and write speeds.

Of course, the P3 is only a PCIe 3.0 drive, but its speeds of 3,500MB/s are far higher than the 160MB/s you'd expect from a mechanical drive. As we've noted in these pages, SSD prices in general have dropped significantly, and we'd recommend going for the Lexar NM790 4TB for $245 (or $250 with heatsink)—it offers PCIe 4.0 speeds and has a five-year warranty. It'd be the option I'd go for just for future-proofing in case I wanted to use the SSD as an internal system drive in a future build or laptop.

That said, I still can't bring myself to get rid of a Seagate 5TB Back Up Plus Portable Drive that I've had for nearly six years. I've read enough of our writer Nick Peers' data protection tutorials to know you can never have enough backups, and despite having a NAS and cloud storage subscription, I still keep a separate backup on a pretty old mechanical drive. Perhaps it's time to get an upgrade, too. ⏻

THE BUILDS

THIS MONTH'S STREET PRICES...

BUDGET

YOU MAY HAVE HEARD a rumor that Intel's last two generations of chips haven't been great on the stability front, with reports of multiple errors and system issues. We're starting to get unofficial reports that this is more than just a micro-code issue. In fact, it's related to the manufacturing process itself, and possible oxidation occurring as a result. Until Intel comes out with a statement or some form of fix (rumor has it that it may reduce the multiplier on the 14th and 13th gen to just x53, and drop memory support to 4,800 MHz), we simply can't in good faith fully recommend the Raptor Lake chips.

On top of that, deadlines are a fickle thing, and right now, AMD's 9000 gen chips are just two weeks away from launching. That means the pricing on the 7000 chips below may radically change in the coming weeks. No doubt the 9th gen chips will be in these pages in the next couple of issues.

Our budget builds haven't changed that dramatically. The biggest shift is on the pricing front. The 4000D has had its RRP slashed by $15, bringing it down to just $80. This is in line with NZXT's H7 Flow 2022, also falling to just $70.

Otherwise, pricing has remained relatively stable. We did have to shift out an AMD board for the Asus Prime B650 Plus (sadly, the Gigabyte Eagle AX from last issue had a $20 price hike), but otherwise, we're all good here. You still get PCIe 5.0 on that as well, so there's plenty of upgradability on it later down the line.

For our Intel rig, 12th gen also fits in the latest chipset boards, so there's not much to change here. We've opted for the 12600KF, as it's a fairly reasonable $146. It still packs in six performance cores and four efficient cores, all clocked at 4.9 GHz, although you will need a cooler. We've factored that into the price below, and recommend Be Quiet!'s Dark Rock Slim for just $60. Amazingly, with all that, we've still managed to shave off $1 from last month.

AMD INGREDIENTS

PART		PRICE
Case	Corsair 4000D Airflow	$80
PSU	600W Thermaltake Toughpower GX2 80+ Gold	$56
Mobo	Asus Prime B650-Plus ATX **NEW**	$140
CPU	AMD Ryzen 5 7600	$193
GPU	ASRock Challenger D Arc A750 8GB	$200
RAM	32GB (2x16GB) Patriot Viper Venom @ 6000 C36	$89
SSD 1	512GB ADATA Legend 840 PCIe 4.0 M.2	$45
SSD 2	1TB Kingston NV2 PCIe 4.0 M.2	$58
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32

Approximate Price: $893

INTEL INGREDIENTS

PART		PRICE
Case	Corsair 4000D Airflow	$80
PSU	600W Thermaltake Toughpower GX2 80+ Gold	$56
Mobo	ASRock B760M-HDV/M.2 Micro-ATX	$98
CPU	Intel Core i5-12600KF + Cooler **NEW**	$208*
GPU	XFX Speedster SWFT 210 Core RX 7600 8GB	$250
RAM	32GB (2x16GB) Silicon Power Value Gaming @ 6000 C30 **NEW**	$85
SSD 1	512GB ADATA Legend 840 PCIe 4.0 M.2	$45
SSD 2	1TB Kingston NV2 PCIe 4.0 M.2	$58
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32

Approximate Price: $912*

MID-RANGE

OUR MID-RANGE BUILDS are also seeing some significant pricing shifts, with that H7 Flow falling by a staggering $20. We suspect this is down to a number of cases now entering the market, providing top-tier feature sets at a lower price, and forcing manufacturers to shuffles prices down to compete as a result.

For our AMD build, we've had to shift to another motherboard, moving to the Asus Prime X670-P WiFi. Unfortunately, our other board had been bounced up. Similarly, the 7900X3D increased by $60. That's challenging to justify, and again may be in part due to Intel's struggles and reputation shift. AMD moving its 'gaming' CPUs into that price point could be a sound tactical decision, albeit frustrating for us. We've opted to drop it in favor of the Ryzen 7 7700X. It's more akin to the 7800X3D on core count, but still provides solid mid-range performance. It also brings our CPU price down by $130, and $70 compared to last month.

Also on the annoying side of things is the GPU for our AMD system, as it's no longer available at all. On top of that, you can't get a 7700 XT for anything less than $390, bumping us up again by $10. We've gone for Asus's Dual OC Radeon chip in the meantime, which should provide comparable performance.

As for our Intel system, aside from the major CPU change yet again, the only other thing we've swapped is the cooler: Cooler Master's MasterLiquid ML360L. Yes, it does look like the same name as last issue, but fortunately it's $5 cheaper, and our other pick has had its price increased.

As for the chip, we've gone with Intel's Core i7 12700K. That slides in at just $221, and packs in eight performance cores and four efficient cores at 5GHz, giving us 20 threads. You've still got DDR5 and PCIe 5.0 support, and some potent single-core performance. You even get two extra performance cores. Thanks to that CPU swap, we've lost $115 off the price, too.

AMD INGREDIENTS

PART		PRICE
Case	NZXT H7 Flow	$70
PSU	850W Thermaltake Toughpower GF1 2024 80+ Gold	$95
Mobo	Asus Prime X670-P WiFi **NEW**	$200
CPU	AMD Ryzen 7 7700X **NEW**	$259
Cooler	Noctua NH-D12L Chromax.Black	$100
GPU	Asus Dual OC Radeon RX 7700 XT 12GB **NEW**	$390
RAM	32GB (2x16GB) Silicon Power Xpower Zenith Gaming @ 6000 C30	$100
SSD 1	1TB Lexar NM790 w/Heatsink M.2 PCIe 4.0	$79
SSD 2	2TB Silicon Power UD90 M.2 PCIe 4.0 SSD	$100
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$1,425**

INTEL INGREDIENTS

PART		PRICE
Case	NZXT H7 Flow	$70
PSU	850W Thermaltake Toughpower GF1 2024 80+ Gold	$95
Mobo	MSI Z790-S Wifi ATX	$170
CPU	Intel Core i7-12700K **NEW**	$221
Cooler	Cooler Master MasterLiquid ML360L ARGB V2 360mm AIO **NEW**	$80
GPU	MSI Ventus 2X OC RTX 4070 12GB	$545
RAM	32GB (2x16GB) Silicon Power Xpower Zenith Gaming @ 6000 C30	$100
SSD 1	1TB Lexar NM790 w/Heatsink M.2 PCIe 4.0	$79
SSD 2	2TB Silicon Power UD90 M.2 PCIe 4.0 SSD	$100
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$1,492**

TURBO

IT'S FINALLY HAPPENED—well, it does happen, but very rarely. Our AMD build has received zero changes. Yep, incredibly there's just nothing that really warrants a swap. Our CPU of choice, the 7950X, received a $53 price increase. That's no small thing. Usually, that would warrant us swapping out a major component for something cheaper, particularly since we want to keep that CPU, as it's the best AMD has to offer right now, at least for productivity. But weirdly, pretty much everything else got a price drop. The PSU—$20. Case—$10. RAM—$20. SSD—$40. Cooler and secondary SSD? Stable. It's kind of crazy, and a rarity, so we left it as it was. The spec is solid, and thanks to those price drops,the 7950X's price bump has been effectively mitigated.

Intel's build has again seen some change. This time, we've swapped the 14900K for the 12900KS. That's not quite as dramatic a loss in power as you might think, either. Although the 14900K does technically have more cores, they're mostly efficient cores. The two are on par for Performance units. Clock speeds are slightly disadvantaged, however, as the 12900KS does only pack in 5.5 GHz, but given that we might be seeing a 5.3GHz max on that 14900K soon, who knows.

We've also swapped out the memory using the same kit across both systems. The TeamGroup kit has dropped by $20, and at $160 for 64GB versus $150 for 48GB, it was a no-brainer, really. For that price, you just can't say no. Ultimately, that has led to this system having its total cost absolutely hammered versus last month, falling by an outstanding $347. In fact, we might have to get all these chips in to see just how well they compare by modern standards. Just how much performance are you losing by dropping from the 14900K to the 12700KS?

Hopefully, within the next month or so, both of these situations will get resolved. We should see AMD with its latest 9000 chips run riot in the benchmarks, and possibly on the pricing front, too. Similarly, if Intel can get a fix out for its 14th series, then we might just be alright. For the time being, though, it's probably best to hold on to those savings for the summer break, at least.

AMD INGREDIENTS

PART		PRICE
Case	Phanteks Enthoo Pro 2 Tempered Glass	$140
PSU	Super Flower Leadex Platinum SE 1000W - 80+ Platinum White	$125
Mobo	Asus Prime X670E Pro WiFi - AM5	$279
CPU	AMD Ryzen 9 7950X	$540
Cooler	NZXT Kraken 360 - 360mm AIO	$180
GPU	ASRock Phantom Gaming OC Radeon RX 7900 XTX 24GB	$910
RAM	64GB (2x32GB) TeamGroup T-Create Expert @ 6000 C34	$160
SSD 1	2TB MSI Spatium M570 HS PCIe 5.0 M.2	$200
SSD 2	2TB Lexar NM790 PCIe 4.0 M.2	$135
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$2,701**

INTEL INGREDIENTS

PART		PRICE
Case	Phanteks Enthoo Pro 2 Tempered Glass	$140
PSU	Super Flower Leadex Platinum SE 1000W - 80+ Platinum White	$125
Mobo	Gigabyte Z790 Aorus Elite AX-W ATX	$292
CPU	Intel Core i9-12900KS **NEW**	$300
Cooler	Corsair iCUE H150i RGB Elite - 360mm AIO	$130
GPU	PNY Verto Overclocked RTX 4080 Super 16GB	$960
RAM	64GB (2x32GB) TeamGroup T-Create Expert @ 6000 C34 **NEW**	$160
SSD 1	2TB MSI Spatium M570 HS PCIe 5.0 M.2	$200
SSD 2	2TB Lexar NM790 PCIe 4.0 M.2	$135
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$32
Approximate Price:		**$2,474**

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